Electric Service for Hotels and Office Buildings

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▾ ▾

A Report of the ▾ ▾

General Power Committee,
Commercial National Section

National Electric Light Association
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Electric Service for Hotels and Office Buildings

Foreword

The purpose of this report is to compile information and data on the use of electric service in hotels and office buildings, which will serve as a guide for engineers, architects and the owners of such buildings or buildings of a similar character, in selecting a source of electric service.

The report generalizes on the application of purchased electric service. It brings out the tangible and intangible advantages of such service; indicates methods used in the territory of one operating company to obtain fundamental data necessary for the study of such applications and gives actual operating data on a number of buildings which can be used as a basis for comparison in setting up similar data for a proposed building.

Preliminary Considerations

The artist, before stretching his canvas or applying his brush, conceives the finished picture in his mind. The inspiration has come. Its mark is a mind picture and the senses which move the creative implements mould the materials available into the inspired form. Similarly the designer, builder and engineer of commercial ventures are moved to the erection of huge commercial buildings, save that such inspirations involve financial considerations. Any inspiration is followed by such considerations, usually preliminary at first, and later by detailed studies and analyses.

The architect and engineer will first survey the purpose of the project. If it is to be an office building or hotel it must be so planned, erected and operated to give services of many varieties. These services must be supplied; first, in an attractive and unique manner and different from the ordinary if they are to draw patronage; second, in a practicable and safe manner and third, in a financial manner that is economically sound. To "dress up" the appearance and catch the client's eye is the architect's problem. To supply the service under such conditions is the engineer's job. In short, human needs and desires are behind the architect's pen and the engineer's curves and diagrams.

After the preliminary plans have been sketched, the problem of supplying the necessary services must be attacked. The demands for heat, refrigeration, ventilation, communication and electrical energy, dressed in a veneer of art and domesticity to conceal the mechanism of personal service institutions, require careful basic analysis. The modern hotel and office building with their assemblage of power services are by their very nature more or less complicated.

Food, comfort, convenience and cleanliness are clearly the basic factors in the problems. Food means electricity and steam for cooking, hot water for dish washing, refrigeration for preservation and preparation. Comfort means heat in the winter, air conditioning in summer and ventilation all through the year. Convenience means elevator service, light, and systems of communication operated by air and electricity. Cleanliness means baths, hot and cold, steam and hot water for laundry, and vacuum for cleaning.

All of these are nothing more than the elements of the engineer's heat balance, expressed in human values instead of British Thermal Units. These are, therefore, the beginning and the end of the power service problems in every great building, whether it be a theatre, hospital, office building or hotel.

Each building is a new pattern composed of the same basic elements. Ability to handle new combinations is acquired, in part, by studying those already in existence. Breadth of view is as important as experience and technical knowledge. The observation that "in the last analysis, it's all a matter of dollars and cents" is trite but fundamental. The dollar value of many of the intangible advantages of purchased services over private production cannot be set up in the balance sheet, but these advantages cannot be overlooked when the safety, convenience, and comfort of the building's clientele are being considered. This is extremely important since the owner of a hotel or office building is faced with increasing competition in selling his services to the public.

Purchased power service is convenient because it is always ready and available by the mere turning or throwing of a switch. Operations are greatly simplified with a minimum of labor, and many mechanical complexities are absent. With purchased power, there are no power plant break-downs for the building owner to worry about. There are fewer labor problems to contend with. It greatly reduces the responsibilities of the building manager and gives him more time to devote to other features tending toward better service for tenants or guests, and greater economy for the owners.

A building operated with purchased service can be kept clean with much less effort than a building with an isolated plant. There is less grease, ash dust, coal dust and smoke. The reduction of these has a decided effect on both the interior and exterior cleanliness of the building. This appeals to the building owner or manager because he usually has some civic pride and takes more or less interest in the cleanliness and attractiveness of his community. It is certainly desirable to keep at a minimum the number of smoking stacks, rumbling coal and ash trucks delaying traffic and spilling dust and dirt along the thoroughfares of a community.

The comfort of tenants or guests is uppermost in the building operator's mind. The environment of employes determines to a great extent their effectiveness. The temperature in the basement of some of the larger office buildings with private power plants has been found to be from 110 to 120 F in the summer time and from 95 to 105 F in the winter time. After working under such conditions all day and then going out into an atmosphere of 30 F or even zero temperature the employe is subject to sickness. Unless provisions are made to prevent it, large volumes of this hot air carrying dust and fumes, will rise from the engine room through the building by way of pipe and cable shafts, elevator shafts and stairways making the building less comfortable for occupants, particularly in the summer months. The first floor, the most valuable space in the building and often occupied by the owners for general offices where contact is made with the public, often suffers most from the heat, noise and fumes of an engine room in the basement. The above difficulties will be reduced if power is purchased and entirely eliminated if both steam and power services are purchased.

The public always considers the "quality of service" as well as the price. The constant upward trend of standards of living, demands the best of everything. This calls for proper lighting, fast elevator service, proper ventilation

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and assurance of performance on the part of equipment in use. Proper application and regulation of the supply of electric service are necessary to give such quality. The building operator who uses purchased current has at his disposal through the electric service company a corps of men trained in the solution of such problems.

The sole reason for anyone becoming a "Jack-of-all-trades" is a sense of self dependability or the feeling that if you want a thing done right you must do it yourself. Buildings which furnish their own electric service suffer from the same "Independent Complex." The realization of this occurs when trouble strikes at the vital points and paralysis sets in. Trouble of this nature is always more deep seated and requires more resources than are usually available. In the electric service companies, specialists in the arts of production and distribution of electrical energy are gradually eliminating even the possibilities of any break in continuity of service. As a result, when an interruption does occur, it cannot be of long duration and if necessary the vast system of interconnections with other central sources of power is brought into play and service is continued with little inconvenience to its customers.

The multitude of details and costs involved in the operation of any large commercial building venture entails quite an expense in accounting records and allocation of these costs to the proper accounts. Using a unit basis such as per room or per square foot of rentable space and having the total electric service cost in one statement simplifies this procedure greatly. With purchased service this becomes of little consequence. Many items of expense are covered in one bill—the power bill. The electric meter gives at all times an accurate and quick account of the cost in a simple manner.

The public has been educated to a great extent in the use of electric service and accidents are rare. Contrast to this the possibilities of accidents present in the operation of boilers and engines.

A building is no different from a piece of furniture in that it becomes "old fashioned" with the progress of time. New services, such as increased illumination, flood lighting, etc., are added to attract tenants and guests. This requires additional service capacity. Increasing plant capacity is often an awkward situation and a costly one. To burden the electric service company with this problem requires but notice of such plans and the solution is simple. Adding to plant capacity for services of low load factor increases production costs very rapidly.

At night and during Sundays and holidays, office building loads are light and the power plant must be run at a low efficiency or shut down entirely. If it is shut down, as is done in some cases, it will be an inconvenience to some employes or tenants. Purchased service is always available in any desired quantity and the consumer pays only for what he uses.

Delivery of fuel and the removal of ashes usually means blockading of sidewalks and streets. This inconvenience is reduced considerably with purchased electric service and can be eliminated entirely if purchased steam service is available.

Cost Considerations

The builder or designer of a prospective office building, hotel or other commercial structure must of necessity give close study to the costs of operating such structures after erection, to the end that the highest economies can be effected and that the maximum return may be realized on the investment. The consulting engineer cannot afford to overlook the purchase of heat and power if such services are available as very often this procedure offers the solution to the operating problems and simplifies selection of equipment.

In the case of a building already generating all services in a private plant, economical operation is equally important. If the building manager has records of his plant performance it is possible for him to check up and arrive at a unit cost for supplying services from his own plant. He must include fixed charges on future investments, determine depreciation of present equipment, carefully weigh the intangible and tangible advantages of purchased service and obtain from the utility which supplies these services an estimate of the cost of operation applied to his particular case and condition. He will at least determine whether his present operation justifies continuance or a change to purchased service effects material advantages which cannot be disregarded.

An analysis of the cost of power for an office building or hotel involves also the cost of heat as both power and heat are supplied from the isolated plant. This together with the many other services required by such buildings, namely, hot and cold water, cooled drinking water, elevator service, ventilation and compressed air makes the analysis rather lengthy and complex. In the case of hotels, kitchens and laundries usually add to the problem. But the analysis is not difficult if the operation of each piece of power plant equipment is carefully studied.

Collecting Data

Figs. 1-a to 1-i inclusive show forms or questionnaires which can be used to advantage in collecting the data required in the analysis of power costs. Perhaps the process of analyzing these costs can best be described by going over these forms.

General Information

Fig. 1-a merely gives the name and location of the building, the names of parties interested in the study, with a brief description of the building and the principal power plant equipment.

Fig. 1-b provides for a continuation of the description of the principal power plant equipment and a record of the current generated. The current generated should be determined by meters installed. They should record the facts in regard to the power generated in the same manner as the utility's meters used for billing purposes would record the current used. If monthly charges are based on a 15-min maximum demand then the test meters should record this demand.

Fig. 1-c is a form to be used in estimating the cost of installing an isolated plant and will be used only where a plant is being considered.

Operating Costs

Fig. 1-d gives an itemized account of the isolated plant operating costs. It is extremely important that the data here be complete and exact. Unusual conditions may produce items not listed in this form.

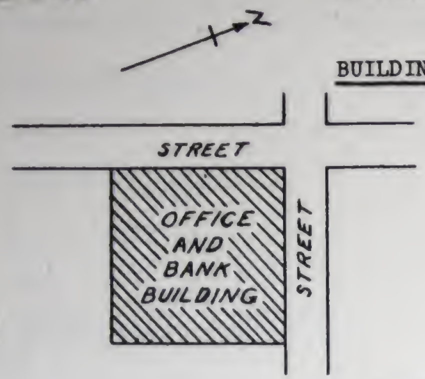
The value of space made available by eliminating power plant equipment in new buildings and removing such equipment from existing buildings should not be overlooked. It is rarely that such space cannot be put to good use and bring some return. That there is a demand by tenants for space below street level has long been recognized by progressive operators of real estate. The advantageous utilization of areas of this kind has been made possible by improved types of equipment which eliminate heat, noise and dirt and add greatly to the desirability and value of basement spaces. These methods include substitution of electrical for steam driven machinery, the use of overhead driven elevators and better lighting and ventilating systems.

In office buildings this space can be used for basement lockers, storage of records, correspondence, merchandise and supplies, restaurants, barber shops and garage storage. Department stores have used such space for bargain basements, packing and delivery rooms, service desks and storage. Hotels place retail shops, coffee grills, garage storage, recreation rooms and night clubs in basement space.

POWER PLANT SURVEY

Data on plant of 22 story Bank and Office Building

Address Pittsburgh, Pa.



BUILDING DESCRIPTION

Width 84' Length 86'

Height 260' No. floors 22

No. of local elevators 3

No. of express elevators 3

No. of freight elevators 0

POWER PLANT EQUIPMENT

Prime Movers

Item	No.	H.P.	Manufacturer	Cylinder Dimensions	RPM	Type	Age
1.	2	201	Ball Engine Co.		210	Tandem Comp.	
2.	1	100	" " "		265	Simple	
3.	1		Murphy Iron Works Stoker Eng.	2-Cyl.	160	Sing. Act.	
4.	1		American	7 x 7		Simple	
5.							

Generators

Item	No.	K.W.	Manufacturer	Phase	Volts	Cycles	RPM	Age
1.	1	75	Westinghouse	D.C.	125		265	
2.	2	150	Westinghouse	D.C.	125		210	
3.								
4.								
5.								

Boilers

Item	No.	Rating	Manufacturer	Type	Press.	How Fired	Fuel
1.	4	150 HP.	Heine	Water Tube	110#	Murphy Stoker	Pgh. Coal
2.							
3.							
4.							
5.							

Fig. 1-a

POWER PLANT SURVEY

Pumps

Item	No.	Cap.	Manufacturer	Type	Cylinder Dimensions	Press.	Speed	Use
1.	1		Wilson Snyder	Duplex	12x28x14x24	180	11	Elev.
2.	2		Wilson Snyder	Duplex	12x18x10x18	180	11	"
3.	2		Wilson Snyder	Duplex	5 x 7 x 15	13	15	Sump.
4.	2		Wilson Snyder	Duplex	5 x 3 x 8			Misc.
5.	2		Wilson Snyder	Duplex	6 x 8 x 12	15		Vac.
6.	1		Wilson Snyder	Duplex	6 x $5\frac{1}{2}$ x 8	10		Air Wash.
7.	2		Wilson Snyder	Duplex	4 x 2 x 6	140		Drink Wat.
8.	1		Wilson Snyder	Duplex	12 x 7 x 18	150		House Pump
9.	2		Wilson Snyder	Duplex	6 x 4 x 10	110		Boiler Fd.
10.			McDrum Howe	Steam jet.				

Compressors

Item	No.	Cap.	Manufacturer	Type	Cylinder Dimensions	Press.	Speed	Use
1.	1		Westinghouse	Locomo.	No. 92910	80		Shone Ejec.
2.	1		Westinghouse	Locomo.	$9\frac{1}{2}$x$7\frac{1}{2}$x10			Elev. Tanks
3.	2		Wilson Snyder	Simple	8 x 6 x 12	20		Shone Ejec.
4.	1	10 T	Frick	Simple				Ammonia
5.	1		Westinghouse	Locomo.	No. 98278	20		Ejectors

CURRENT GENERATED

MONTH	KVA or KW MAXIMUM DEMAND	YEAR KWH
January	141	38,100
February	135	45,900
March	142	37,900
April	140	37,400
May		
June		
July		
August		
September		
October		
November		
December		
Average	140	39,825

REMARKS

Fig. 1-b

POWER PLANT SURVEY

COST OF POWER PLANT EQUIPMENT.

Excavation and Foundation @		per	$	
Building	'X	'X	'@	Per Cu. Ft.
Boilers and Settings @		Per H.P.		
Stokers				
Fuses and Stacks @		Per H.P.		
Blowers (For Boilers Only)				
Pumps and Piping @		Per H.P.		
Coal and Ash Handling Facilities				
Condenser Equipment@		Per K.W.		
Engine No. 1 (Erected) *				
" " 2 "				
" " 3 "				
" " 4 "				
" " 5 "				
" " 6 "				
Generator No. 1 (Erected)				
" " 2 "				
" " 3 "				
" " 4 "				
Exciters				
Switchboards and Wiring @		Per K.W.		
(C)	TOTAL COST OF EQUIPMENT			

*

Fig. 1-c

POWER PLANT SURVEY

COST OF ISOLATED PLANT OPERATION

Fixed Charges:

Interest @ % on $	(C)	$ (Plant Already Installed)
Taxes @ % on $	(C)	
Fire Ins. @ $ per M on $		
Boiler Ins. @ $ per M on $		
Other Ins. @ $ per M on $		
Depreciation % on $	(C)	
(D) TOTAL FIXED CHARGES PER YEAR $		

Yearly Operating Charges:

Labor - Engineers	3 @ $1920	$5760	
Firemen	3 @ 1440	4320	
Repairmen	1 @ 1248	1248	
Coal Passers	3 @1320	3900	$15,228.00
Fuel	Tons @ $ per ton		23,335.00
Fuel	M Cu. Ft. @ $ per M. Cu. Ft.		
Water			2,400.00
Removal of Ashes	tons @ $ per ton		1,200.00
Oil Waste and Supplies			710.00
Maintenance and Repairs			760.00
*Rental Value	sq. ft. @ $ per sq. ft.		

(E)	TOTAL OPERATING CHARGES	$43,633.00
(D)	TOTAL FIXED CHARGES	
(F)	TOTAL COST OF OPERATION PER YEAR	

* Only space which would be made available by removal of plant should be charged against plant operation.

Fig. 1-d

POWER PLANT SURVEY

BUILDING DATA

Type of construction - Brick and Stone furred and plastered.

Thickness of Walls - 18"

Glass - Plate Skylight - None

Roof Construction - Tar and gravel on Concrete Slab.

Building Height - 260

No. of floors - 22

Width - 84' Length - 86'

Volume - 1,740,000 Roof Area - 7220

Estimated Air Changes - one per hour in offices, 3 per hour in bank.

Temp. Maintained - 70° Maximum 65° Ave.

Exposure	Gross Wall	Glass	Net
North			
South			
East			
West			
Court			
Total	77,660	21,000	56,660

Heating System Data

Direct Radiation	15,200		
Indirect	1,895	Equivalent direct	19,625

Type of heating system	Two pipe Vacuum	
Type of boiler		
Size of Vacuum Pump	24,000	Vacuum 8"
Injection Water Used?	No	

Hot Water Heating

Type of Heater	Closed heater	Size	
Estimated Water Requirements	1305 Gal. /hr.	Temp.	160°
Demand Steam	1305 #/hr.		
Consumption yearly	1,128,000		

Other Equipment

Fig. 1-e

POWER PLANT SURVEY

Building

Calculations

Heat losses in B.T.U's. per hr. per degree

	Calculation		Loss
By Infiltration			
Through Air Change	1,740,000 x .020	=	34,800
" " "			
" " "			
" " "			
By Conduction			
Through Walls	56,660 x 0.24 x .7	=	9,500
" "			
Through Roof	7,220 x 0.25	=	1,805
" Glass	21,000 x 1.00	=	21,000
" "			
" Skylight			
Total		-	67,105

(G) Yearly Steam Consumption for Building Heating

67,105 x 128.4 = 8,600,000 # normal year

Misc. Calculations

Demand Calculations

19,625 x 0.3 = 5,887.5 # per hr.

Remarks

Utilization of unit thermostatic control has reduced this consumption considerably. The meter readings show the actual consumption to be considerably below the estimated figure.

Fig. 1-f

POWER PLANT SURVEY

Estimated Average Steam Consumption

Summary

Use	Demand	Consumption
For Building Heating (G)	5,888	8,600,000 #
For Water Heating	1,308	1,128,000 #
For Cooking		
For Process Work		
Total	7,193	9,728,000

(H) Yearly Cost $8,578.25
Net Cost per 1000 pounds $.872

Volume 1,740,000 19,625 Square Ft. of Radiation

#s of Steam for heating / cu. ft. of vol.	4.94
#s of Steam for heating / sq. ft. of rad. (Q)	437.00
Cu. ft. of volume / sq. ft. of rad.	88.70

Miscellaneous

Monthly Billing

Month	%	#s Steam Htg.	Other Uses		Total M#s	Cost
Jan.	20.6	1,771,600	Water Htg.	94,000 #s/Mo.	1,866	$1,567.00
Feb.	17.6	1,513,600	Cooking	#s/Mo.	1,608	1,373.80
Mar.	15.1	1,298,600	Laundry	#s/Mo.	1,393	1,206.90
Apr.	8.0	688,000			782	728.20
May	1.8	154,800			249	256.55
June			Total (J)	94,000 #s/Mo.	94	103.70
July					94	103.70
Aug.					94	103.70
Sept.	0.3	25,800			120	131.00
Oct.	5.6	481,600			576	544.80
Nov.	12.6	1,083,600			1,178	1,034.90
Dec.	18.4	1,582,400			1,676	1,424.50
Total		8,600,000 (G)	(G plus J)	Total	9,730	$8,578.25(H

Fig. 1-g

POWER PLANT SURVEY

Demand & Current Consumption
Central Station Power.

	K.W. or K.V.A. Demand	K.W.H.	K.W. or K.V.A. Demand (a)	K.W.H. (B)
Total as generated			144	42,390
*Deductions for	K.W. or K.V.A. Demand	K.W.H.		
Plant Load			144	42,390
*Additions for Pumps	K.W. or K.V.A. Demand	K.W.H.		
Elevator Pump	124	28,920		
Circulating Pumps	1.5	1,080		
Sump Pumps	2.35	1,100		
Vacuum Pumps	1.09	550		
Compressors				
Air Compressor	1.85	778		
Air Compressor	0	82		
Refrigeration Machine	5.75	2,470		
Miscellaneous				
Indirect Heating System	5.8	2,988		
Vacuum Cleaner	0	1,340		
Exhaust Fan on Roof	0.65	475		
House Pump.	1.65	597		
Estimated Total			144.64	40,380
Total Load Metered (K)			288.64	82,770

Load Factor - 39.9% Estimated Power Factor - 99.6%
Cost of electric service per yr. (L) $16,078.89

*Do not deduct or add demands of equipment which occur during off peak hours.

Fig. 1-h

The 24-story bank and office building referred to in Figs. 2-a and 2-b, offers a splendid example of utilizing a basement formerly occupied by a private plant. Figs. 3 to 6, inclusive, are pictures of the basement with the private plant equipment in use. Figs. 7 to 10, inclusive, show to what advantage this space was used after removal of plant equipment. The ceiling height of this basement permitted construction of a mezzanine floor and made available a total of 12,400 sq ft of space free from any mechanical equipment, for those uses represented in Figs. 7, 8 and 9. Three-fifths of this space formerly was occupied by the engine room and the remainder by the boiler room. In this particular case the possible annual rental revenue was increased by $12,000.00. Fig. 10 shows a typical suite of offices built in the former hydraulic elevator shaft of this same building. By changing the elevator to electric drive and limiting 6 of these to local service to the 16th floor, 2,274 sq ft of space, which was rented immediately for approximately $5,700.00 annually, was released for office purposes.

Another office building with a bank occupying the first and second floors has provided attractive and comfortable rest rooms, wash rooms and locker rooms for employes in the space which was formerly an engine room. Figs. 11 and 11-a indicate this advantageous change. The 1,000 sq ft of space so obtained has a conservative rental value of $1.00 per sq ft per yr.

One large office building in Pittsburgh offers a splendid example of the value of basement space and the uses to which it can be applied. This building has devoted 70,000 sq ft of basement space to a ramp type parking garage, capable of storing 240 cars at an average rental of $18.00 per month per car. In addition, "Archives" of steel shelves for storage, size 6 ft x 9 ft with individual locks are rented to tenants at $10.00 per month. By having these desirable facilities available to the tenants the rental value of the office space has been enhanced materially.

Another large office building has leased basement space for a large high class restaurant. Still another building is now seriously considering purchased service due to a need for additional space for storage of drawings, stationery, correspondence, etc. Removal of their power plant would provide very desirable basement space for this purpose.

Heating Costs

Figs. 1-e, 1-f and 1-g deal with the cost of heating. This phase of the survey is just as important as the analysis of power costs and must be studied very carefully in order to arrive at a correct solution.

The remark is often made that "our power costs us very little because we must have steam for heating and our engines serve as a reducing valve" or "our heating costs us nothing because we use the exhaust steam from our engines." The economy of using the exhaust steam from a power plant in an office or hotel is greatly overstressed. If the heating load curves and the power load curves coincided there would be a decidedly greater economy than actually can be obtained, but for the greater part of the time the curves do not coincide. During certain hours of the day it may be necessary to add live steam while at other times there may be an excess of exhaust steam available. Taking an average for the day may make it appear that there is no live steam required or possibly no excess exhaust. For this reason it is essential to make heat balance studies on an hourly basis.

Obtaining Electrical Usage Data

Fig. 1-h shows a form for calculating the current that would be consumed with the building on central station service. It provides initially for the maximum demand and kilowatthours as registered by the test meters installed. From these readings is to be deducted the current used by electrically driven equipment that will no longer be required when the power plant is shut down. Frequently there is considerable equipment, such as, pumps, fans, coal and ash conveyors, machine tools, etc., which are used exclusively in the operation of the isolated plant. The energy used in the operation of this equipment must naturally be deducted from the total generated. If any of this equipment is used during off-peak hours only, its load is not to be deducted from the maximum demand as established by the test meter.

Provision is made on this form for adding to the current generated any additional electrically driven equipment that will be required with central station service. Usually there are steam driven pumps, refrigerating machines, fans, etc., that must be replaced with motor driven equipment. The estimated demands and energy consumptions of such equipment must be considered in arriving at the total generated. Vacuum cleaning machines are, in most cases, used only at night, i.e., during off-peak hours. The use of air compressors often can be limited to off-peak hours. Care should be taken not to include the load of such equipment in arriving at the total demand. This is of special importance where current is to be purchased on a demand rate.

The result, after making these deductions and additions, is the basis for calculating the central station's bill for electric service.

In addition to the central station's bill for electric service there will be other cost items, such as labor, supplies, maintenance, repairs, etc. If steam for building heating, hot water, cooking, etc., cannot be purchased from a central heating plant, figures covering the cost of producing this steam in an isolated boiler plant must be included. To this must be added the fixed charges on the investment for new equipment required for the use of central station service. The total should represent the complete cost of operating with central station service on this basis of giving the building the same services that it is getting from the isolated plant and comparable with the total cost of operating the isolated plant. In the final analysis, at the bottom of Fig. 1-i, a direct comparison is obtained between isolated plant operating cost and the cost with central station service which shows the tangible advantage in the form of a saving in dollars and cents, if a saving can be effected.

Analyzing Costs

Figs. 12 to 20 inclusive, present typical steam load curves for a 22-story office building, a 360 and 840-room hotel, which give a comparison between the steam required for building heating, hot water service, etc., and the exhaust steam that would be available if power were produced from a private plant. The office building and smaller hotel originally operated private plants, but are now purchasing both electric service and heating service. The cost of light, heat and power for these buildings is given further on in the report. In the case of the 22-story office building, the cost of light, heat and power when produced from its private plant is also given. The 840-room hotel always has purchased all light, heat and power required.

By setting up a series of curves for different outside temperatures it was established that the 22-story office building used only 9.6 per cent of the exhaust steam available during the year for building heating and water heating. The building is used entirely for banking and business office purposes and contains no offices for doctors and dentists. This percentage would be somewhat greater for hotels due to the large quantity of steam required in a hotel for hot water, laundry, cooking, etc., throughout the year. The figure of 9.6 per cent was established in the following manner:

By taking the actual yearly coal consumption under private plant operation and assuming an average evaporation of

POWER PLANT SURVEY

Cost of Operation With
Central Station Service

Operating Charges:

Labor	Engineers	3 @ $1,980	per year	$5,940.00
	Firemen	- @	per year	
	Repairmen	1 @ 1,560	per year	1,560.00
	Laborers	1 @ 1,248	per year	1,248.00
Fuel	tons of coal per yr.		per ton.	
Fuel	M.Cu.Ft. gas per yr.		per M.	
Water	M. Gallons per year		per M.	1,200.00
Removal of ashes		tons @	per ton	
Oil waste and supplies				710.00
Maintenance and repairs				
Miscellaneous				
Electric service (L)				16,078.89
Steam	(H) Actual 1927 cost			6,951.65
(M)	Total operating cost per year			33,688.54

Fixed Charges:

Interest @ 6% on $41,751.00		2,505.06
Taxes @ 2% on 41,751.00		835.03
Depreciation @ 5% on 41,751.00		2,087.55
Insurance @ 1% on 41,751.00		417.51
	Total fixed charges (N)	5,845.15
	Total Operating charges (M)	33,688.54
	(P) Yearly cost of operation	39,533.69

SUMMARY

Total yearly operating cost of isolated plant (D)		43,633.00
" " " " with Central Station Service (P)		39,533.69
(Q) Yearly saving (D-P)		4,099.31
(R) Invest. required	$41,751	

Return on investment = $\frac{D-P}{R}$

Fig. 1-i

6½ lb of water per lb of coal, the water rate per kwhr was established by dividing the total quantity of water evaporated in a year by the total power generated. Since in this case the quantity of live steam used for heating was very small, it was neglected.

The electric power generated was determined by test meters over a period of 4 months (See Fig. 1-b). The equivalent kilowatthours for the power developed by steam-driven equipment other than generators was included in the total power generated. This figure was estimated from close observation of the operation of this equipment.

To arrive at the quantity of exhaust steam available per kilowatthour of power produced, the water rate per kilowatthour was first reduced 15 per cent to allow for condensation losses, leaks, etc. This quantity was further reduced by deducting the steam required for feedwater heating expressed in pounds per equivalent kilowatthour.

A chart was prepared as shown in Fig. 12, giving by months the kilowatthours purchased for one year. The ordinates for the curve showing the exhaust steam available for heating were then established by multiplying the number of kilowatthours used by the exhaust steam available per equivalent kilowatthour.

Hourly readings of the electric service company's meter and the heating company's steam meters were taken over a period of a week in the winter season. The daily electric load curves for each week-day, except Saturday and Sunday, had practically the same contours and were of nearly equal magnitude. An average week-day electric load curve was prepared and from this were prepared the exhaust steam curves in Figs. 13 to 18 by applying the exhaust steam factor as determined above. Such curves were prepared for Saturday and Sunday as shown in Figs. 17 and 18. As the power consumption for this building varied only slightly from month to month, the curves were assumed to be average curves for each such day during the year. If the monthly power consumption had varied materially during the heating season, then such curves would have had to have been prepared for each month.

The steam consumption curves for building heating, as shown in Figs. 13, 14, 15 and 16, were found to have practically the same characteristics for each week-day. The curve for Saturday, given in Fig. 17, and the curve for Sunday, given in Fig. 18, were, of course, found to be quite different.

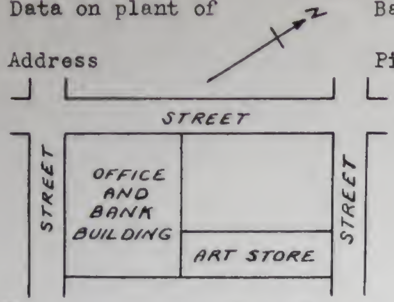
The ratio between each hourly consumption for the day and the total steam used for the day was established in terms of percentage of the total. The average of 5 days results so determined were taken as the actual average. The total daily steam consumption for heating was established by the formula described later in the report for outside temperatures ranging from 0 to 65 F in 5-deg steps. By applying the hourly percentages to these totals, curves were established showing the hourly requirements of heating steam for each 5-deg step. The steam used for water heating was metered separately and the hourly requirements added to the hourly requirements for building heating on each of the curves. Each of these curves was then superimposed on the curves showing the total exhaust steam available for a week-day, a Saturday and a Sunday. This set of superimposed curves gives in graphical form the total exhaust steam available on each day, the steam required for all heating purposes at various outside temperatures, the exhaust steam that could be utilized and the live steam that had to be added when there was not sufficient exhaust steam available.

By measuring these areas with a planimeter it was determined for the outside temperature in steps of 5 deg how much of the exhaust steam available could actually be utilized. The number of weekdays, Saturdays and Sundays in the heat-

BUILDING POWER COST DATA

Data on plant of Bank and Office Building

Address Pittsburgh, Pa. Use of Bldg. Office



Building Description

Width	114.6	Length	134
Height	280	No. of floors	24
No. of express elevators			5
No. of local elevators			5
No. of freight elevators			-

Description of Isolated Plant Equipment

Boilers

Item	No.	Rating	Manufacturer	Type	Press.	How Fired	Fuel
1.	4	250 HP	Babcock Wilcox	W.T.	130#	Chain Grates	Pgh. Coal
2.							
3.							
4.							

Generators

Item	No.	K.W.	Volts	Phase	Cycles	Speed	Driven by
1.	3	150	220	2	60		Phoenix Engines
2.	1	75	220	2	60		Phoenix Engine
3.							
4.							

Isolated Power Plant Operating Costs

Labor	$ 30,330.00
Fuel	38,770.00
Water	1,849.00
Removal of ashes	2,584.00
Oil, waste and supplies	1,170.00
Maintenance	2,708.00
Value of floor space	
Total yearly operating cost	$77,411.00

Fig. 2-a

Operating Cost with Central Station Service

Average monthly maximum demand	448 KW
Average monthly current consumption	11,380 KWH
Total cost of equipping for Central Station Service	$65,000

Yearly Operating Charges

Labor	$13,457.00
Fuel	- -
Water	- -
Removal of ashes	- -
Repairs and maintenance	500.00
Oil, waste and supplies	750.00
Steam service lbs. steam	20,130.00
Electric service	26,737.00
Total Operating Charges	$61,574.00

***Fixed Charges**

Interest 6% on $65,000.00	$ 3,900.00
Taxes 2% on $65,000.00	1,300.00
Depreciation 5% on $65,000.00	3,250.00
Insurance 1% on $65,000.00	650.00
Total Fixed Charges	$ 9,100.00
Total Operating Charges	61,574.00
Total Yearly Cost of Operation	$70,674.00

*Fixed charge to be based on cost of new equipment required for central station service, less salvage value of isolated plant equipment.

Fig. 2-b

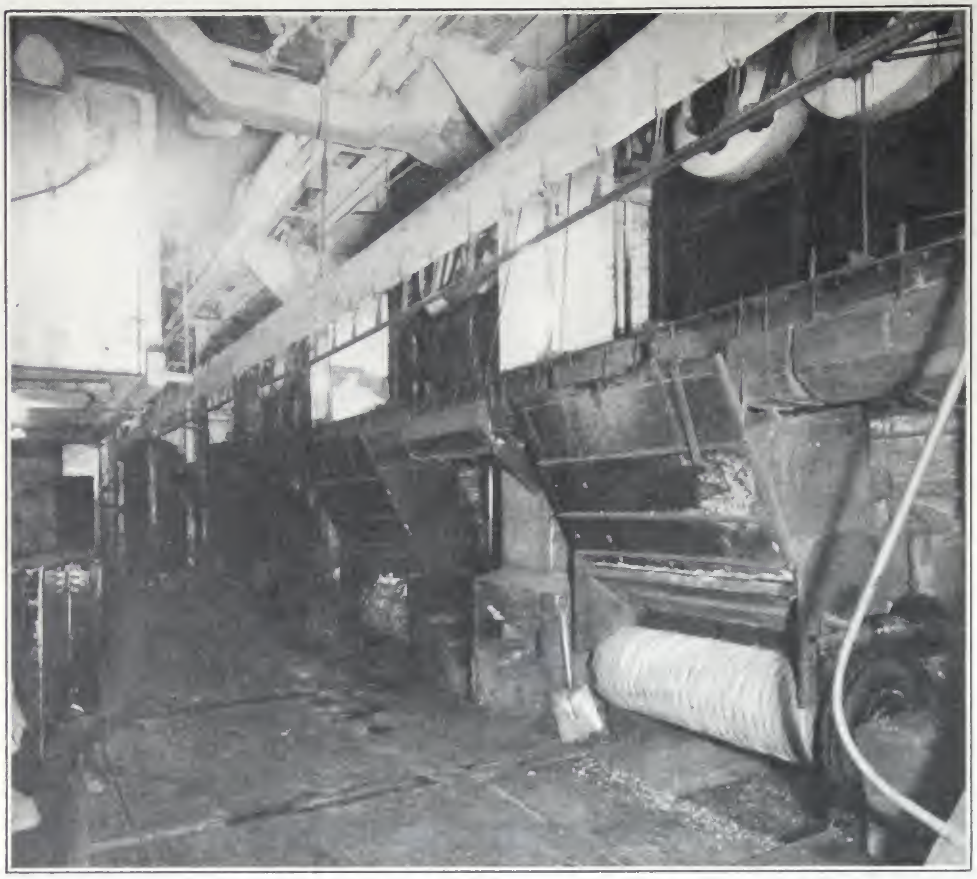


Fig. 3—Former Boiler Room of 24-Story Bank and Office Building. Showing Four 250-hp Boilers

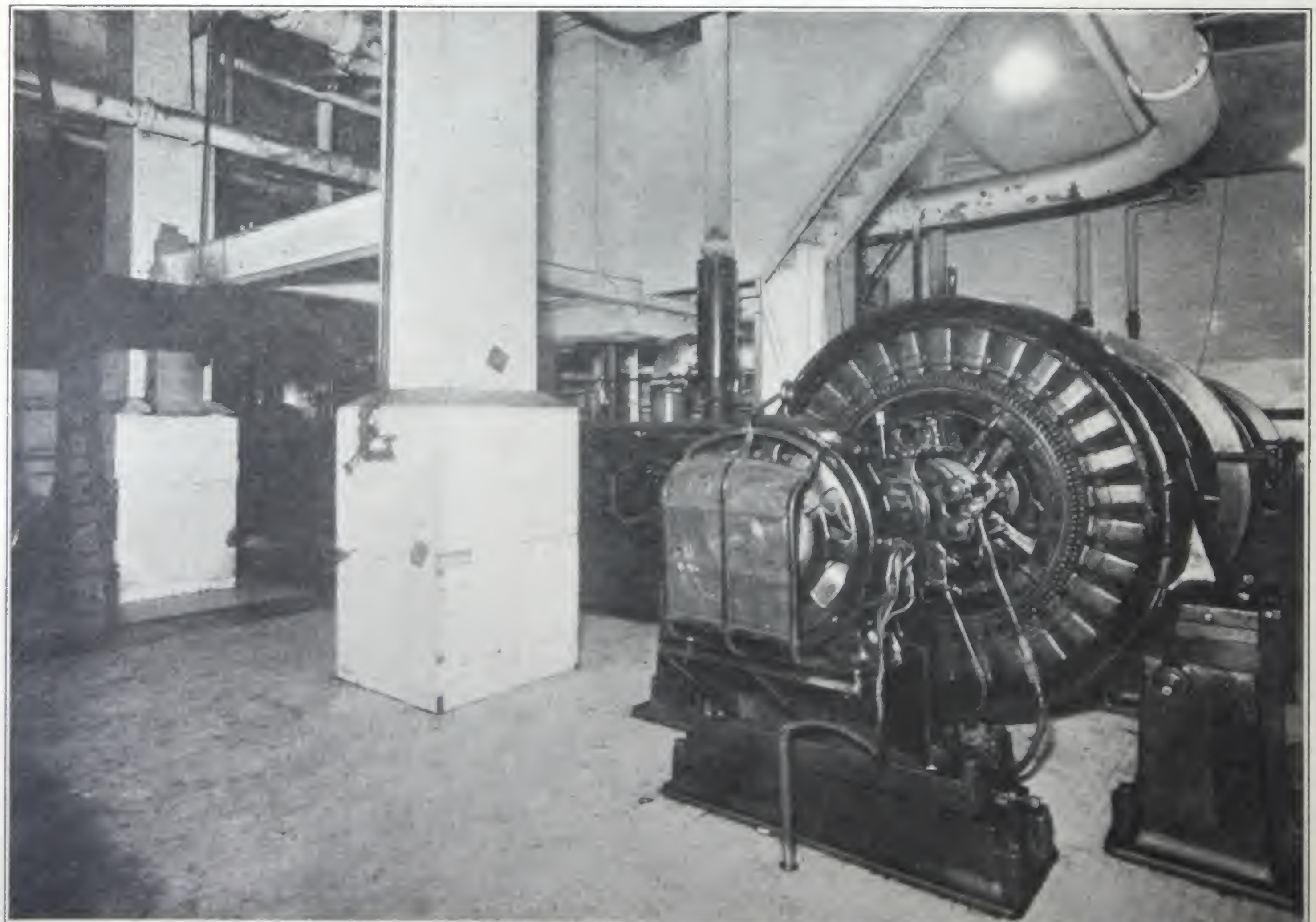


Fig. 4—Former Engine Room of 24-Story Bank and Office Building, Showing Two 150-kva Engine Generator Sets

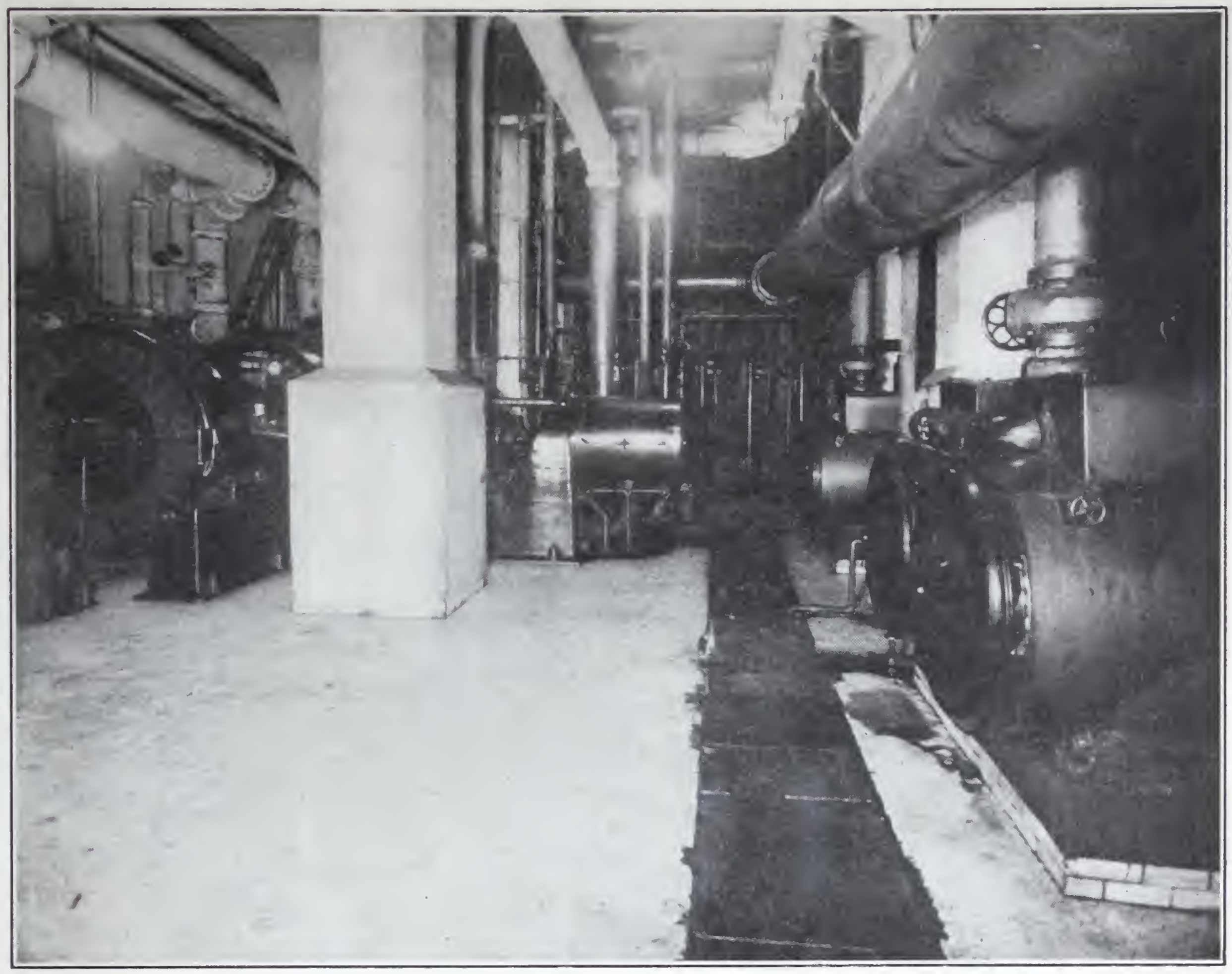


Fig. 5—Another View of Former Engine Room of 24-Story Bank and Office Building Showing 75-kva Engine Generator Set on Left and Elevator Pumps on Right

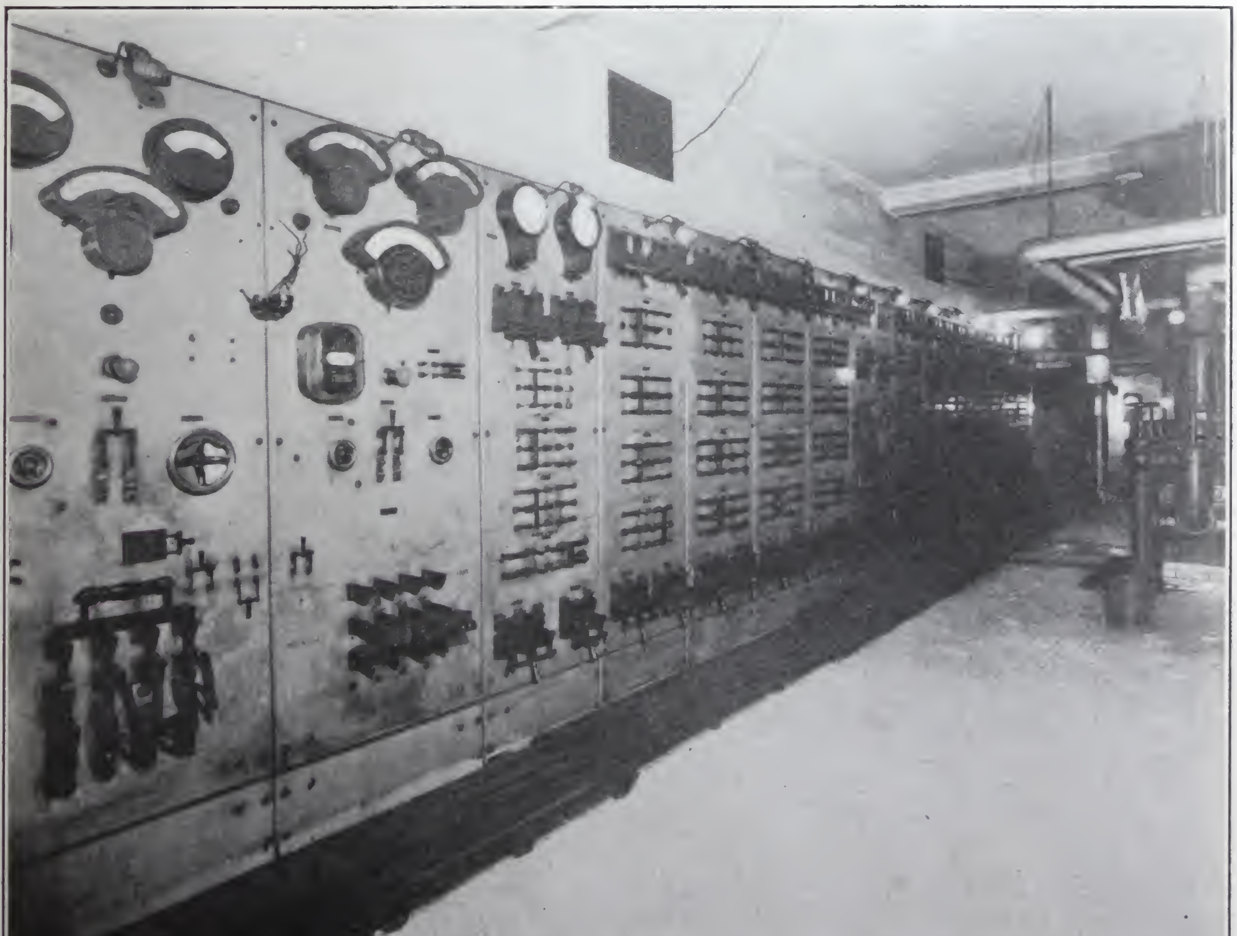


Fig. 6—Switch Board Equipment of Former Power Plant in 24-Story Bank and Office Building

Fig. 7—Former Engine Room — Basement Floor of 24-Story Bank and Office Building Which, Since Central Station Service is Used, Has Become a Sub-Basement for Mechanical Equipment and Storage Space for Tenants

Fig. 8—One of a Number of File Rooms on Mezzanine Floor Installed in Former Engine Room of 24-Story Bank and Office Building

Fig. 9—Several Rooms Such as These Shown Here Were Provided for Bank Customers, for Clipping Coupons in Space Formerly Occupied by Boiler Plant of 24-Story Bank and Office Building

Fig. 10—Typical 2-Room Suite of Offices in Space Formerly Used for Hydraulic Elevators in 24-Story Book and Office Building. This space Was Made Available by Replacing the Hydraulic Elevators with Modern Electric Elevators. Formerly All Elevators Traveled to 24th Floor. Through the Higher Speed of the Electric Elevators Installed, Local Elevators Operate to 16th Floor Only. The Elevator Driving Equipment Occupies the Space of the Former Elevator Shafts on the 17th and 18th Floors. This Space on 19th to 24th Floors Provides Space for Offices as Shown in this Illustration.

Fig. 11—Employe Locker Room in Space Formerly Occupied by Engine Room in 16-Story Bank and Office Building

Fig. 11-a—Officers' Toilet Room Installed in Space Formerly Occupied by Power Plant in 16-Story Bank and Office Building

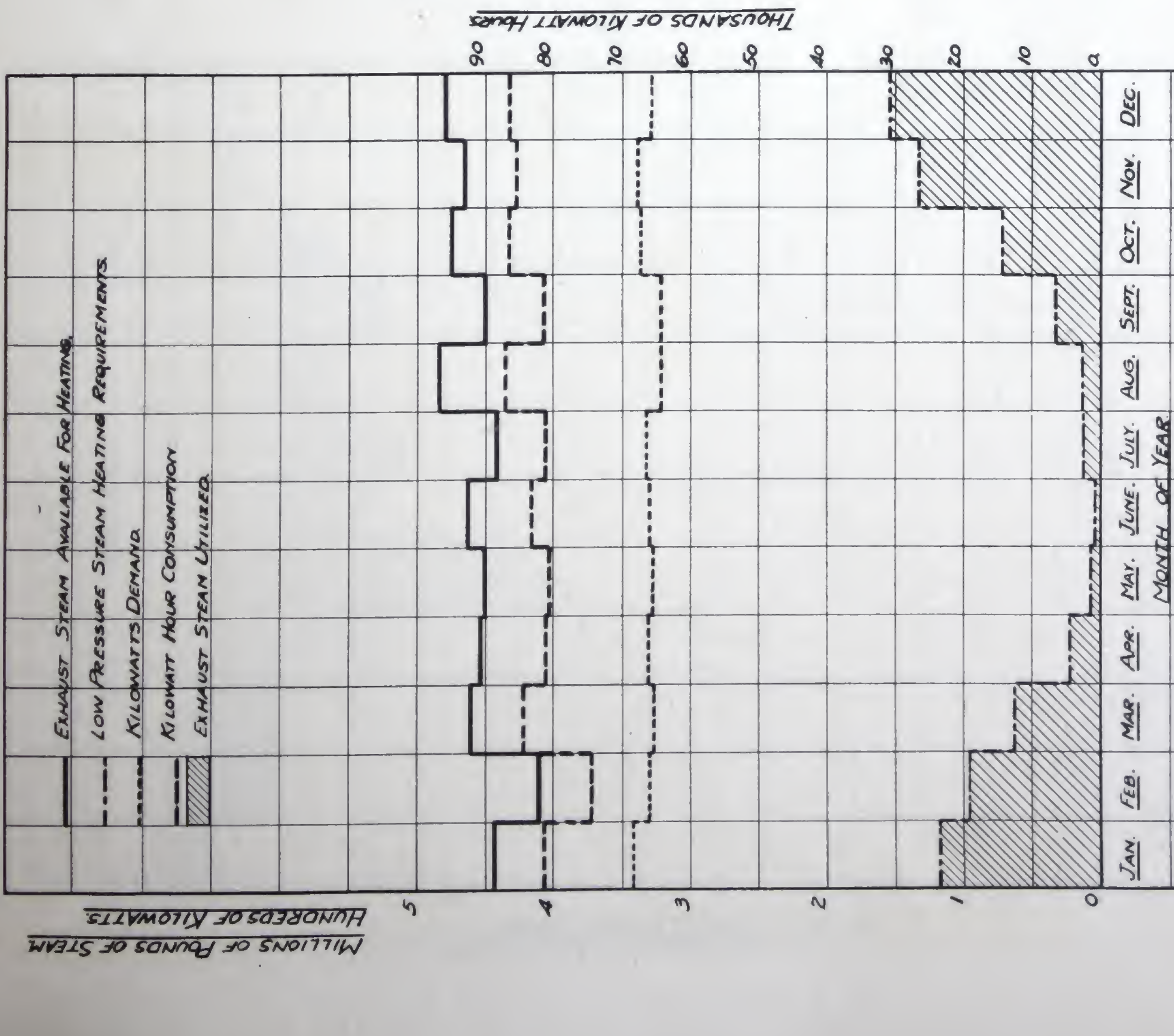


Fig. 12—Twenty-two Story Office Building—Yearly Steam and Electric Load Curves

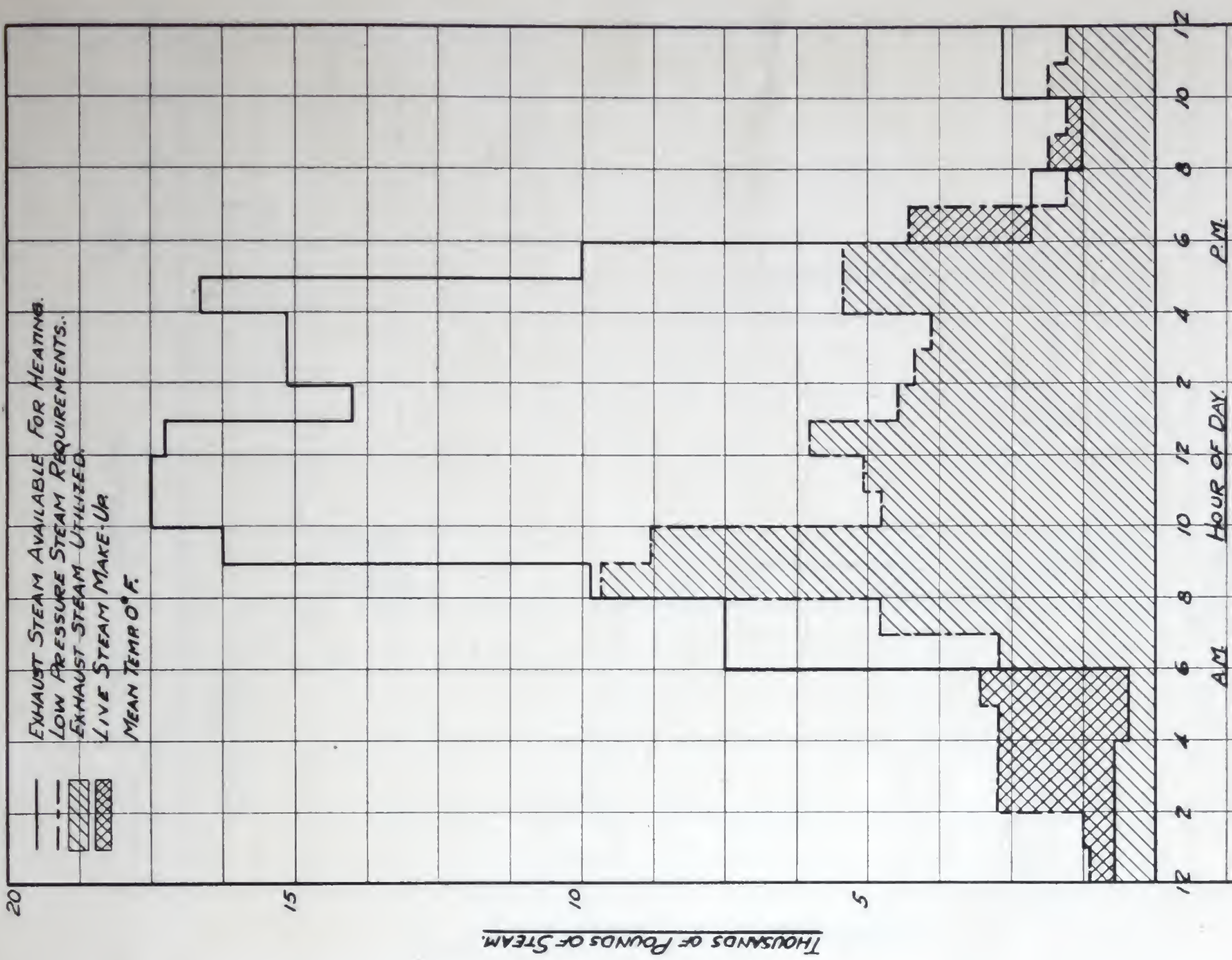


Fig. 13—Twenty-two Story Office Building—Steam Load Curve for Week-day

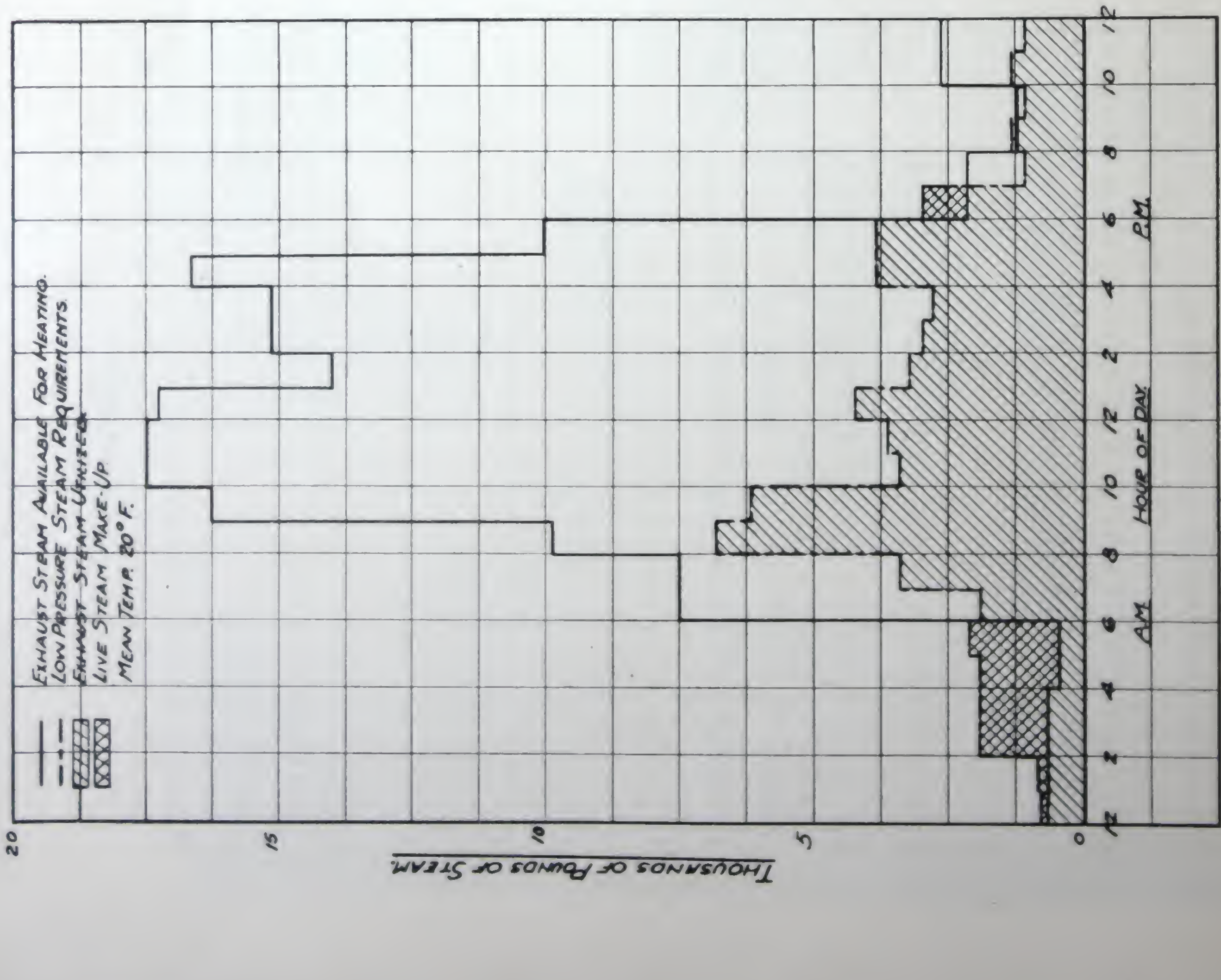


Fig. 14—Twenty-two Story Office Building—Steam Load Curve for Week-day

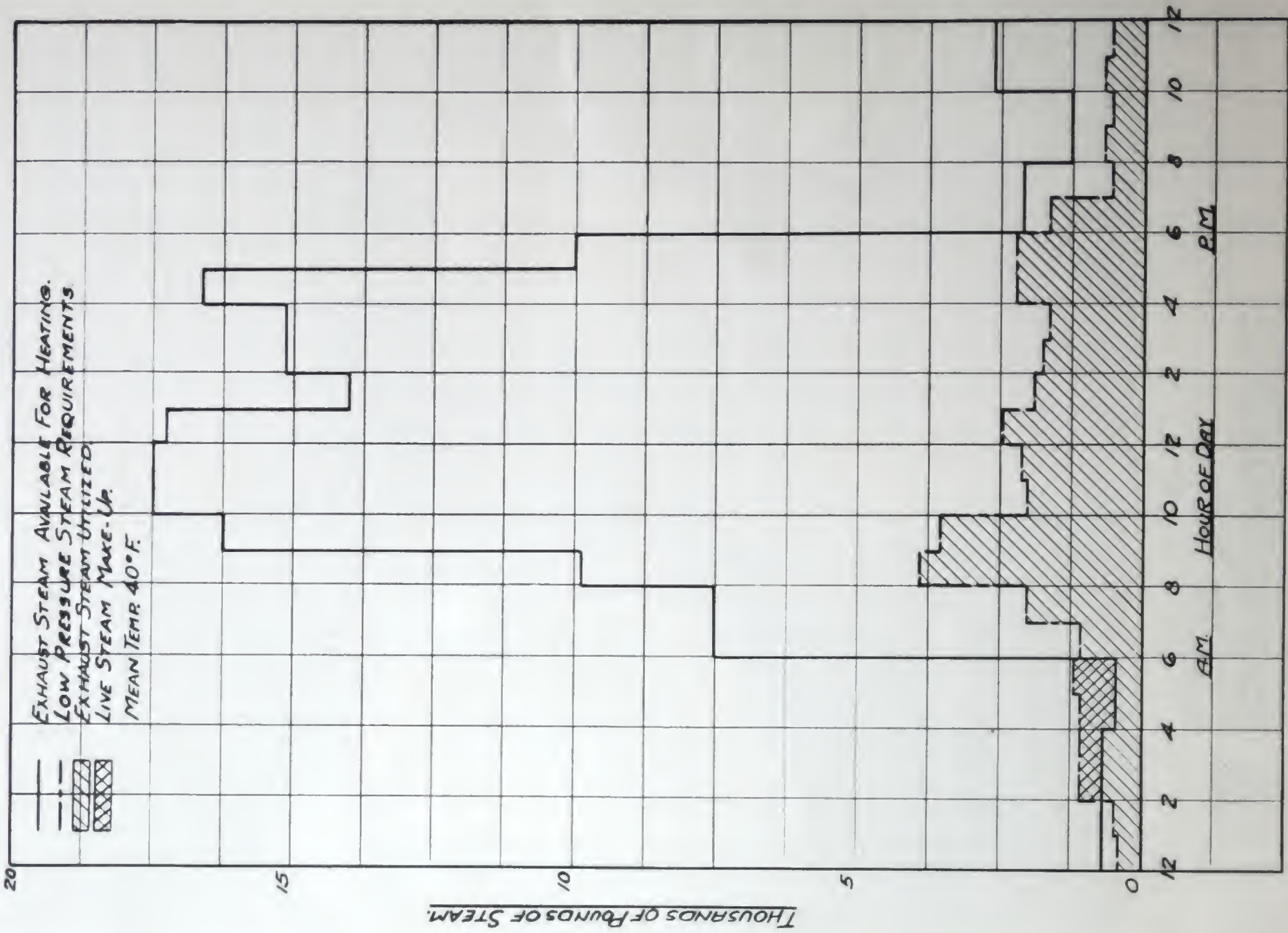


Fig. 15—Twenty-two Story Office Building—Steam Load Curve for Week-day

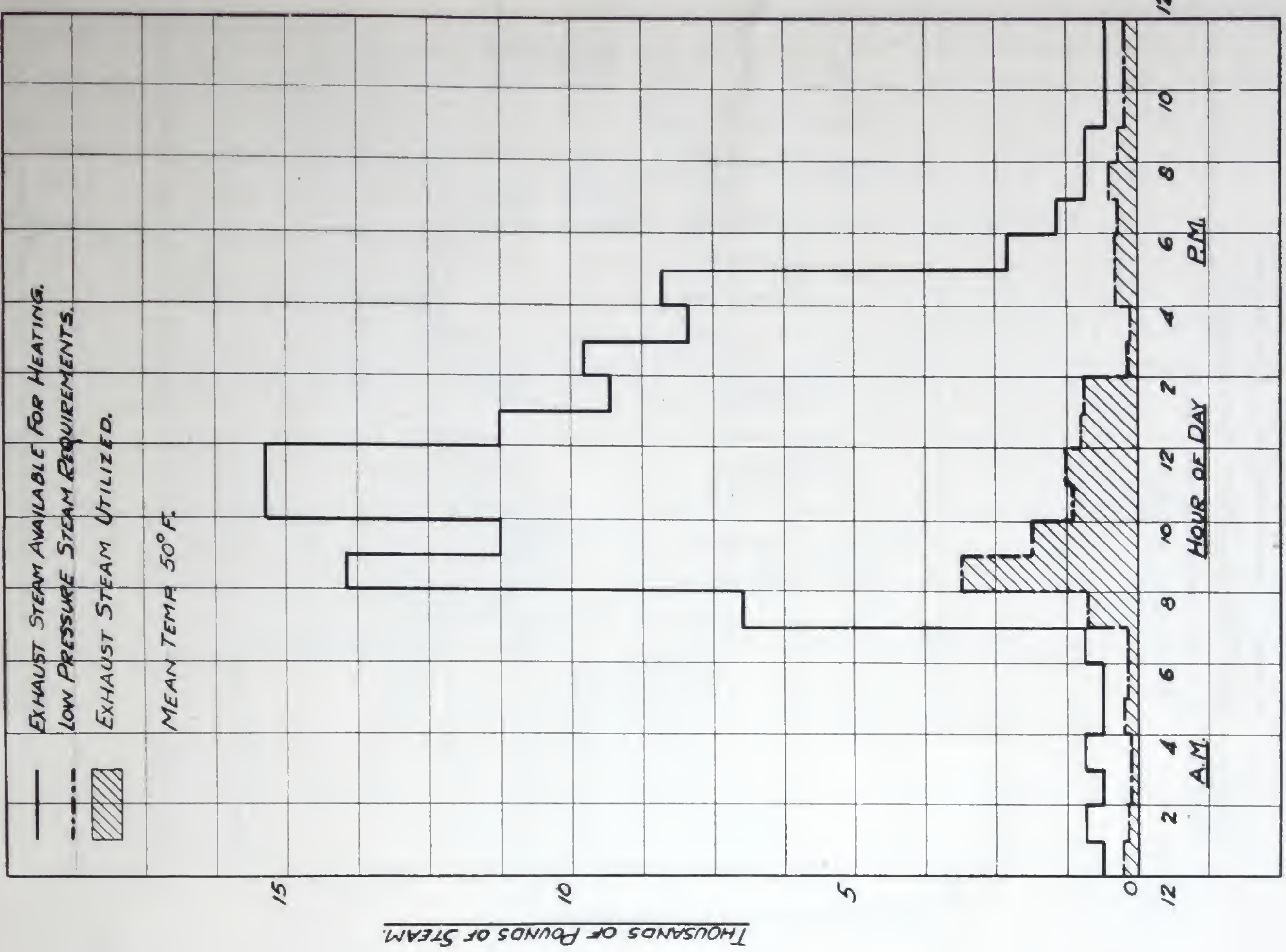


Fig. 17—Twenty-two Story Office Building—Steam Load Curve for Saturday

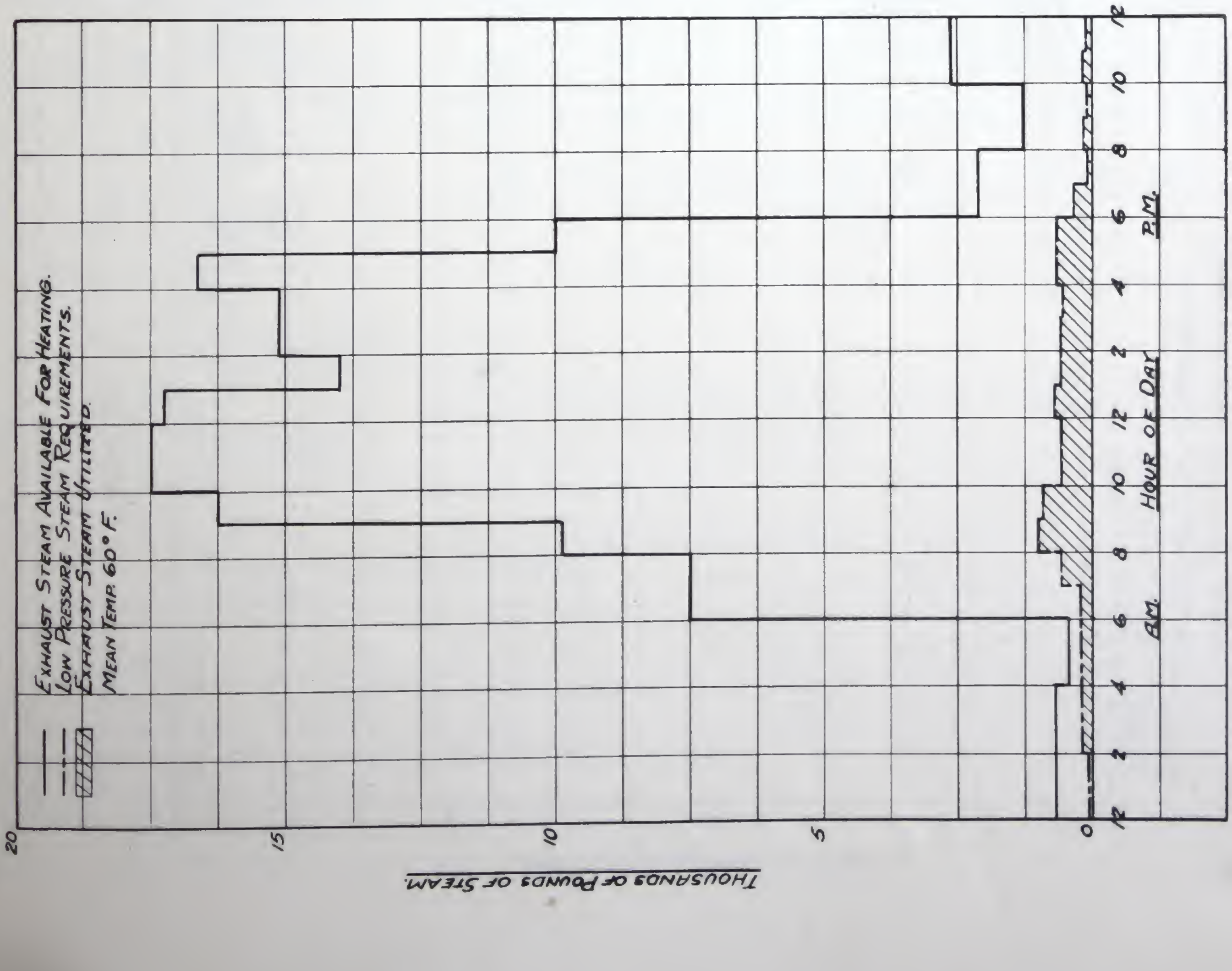


Fig. 16—Twenty-two Story Office Building—Steam Load Curve for Week-day

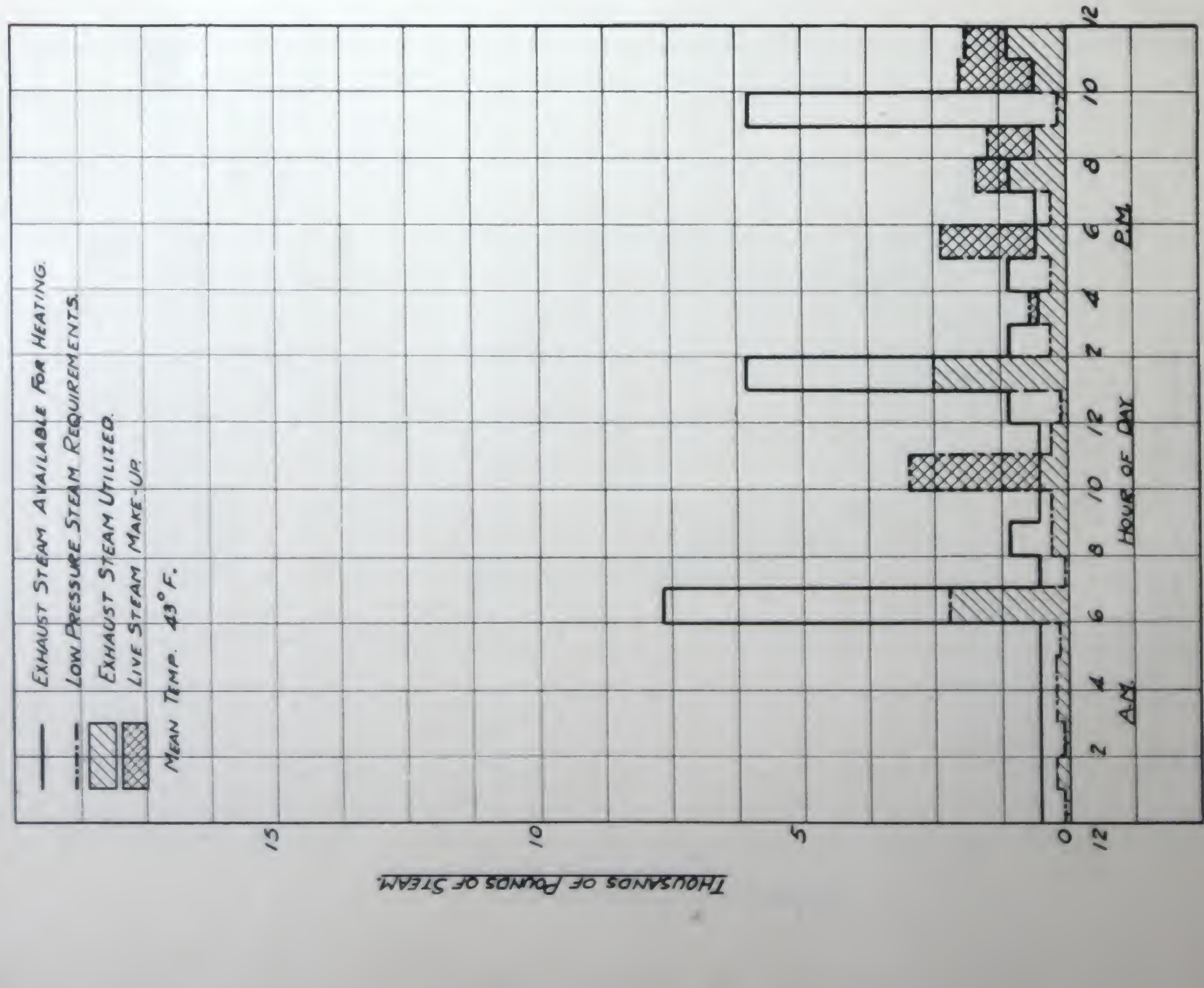


Fig. 18—Twenty-two Story Office Building—Steam Load Curve for Sunday

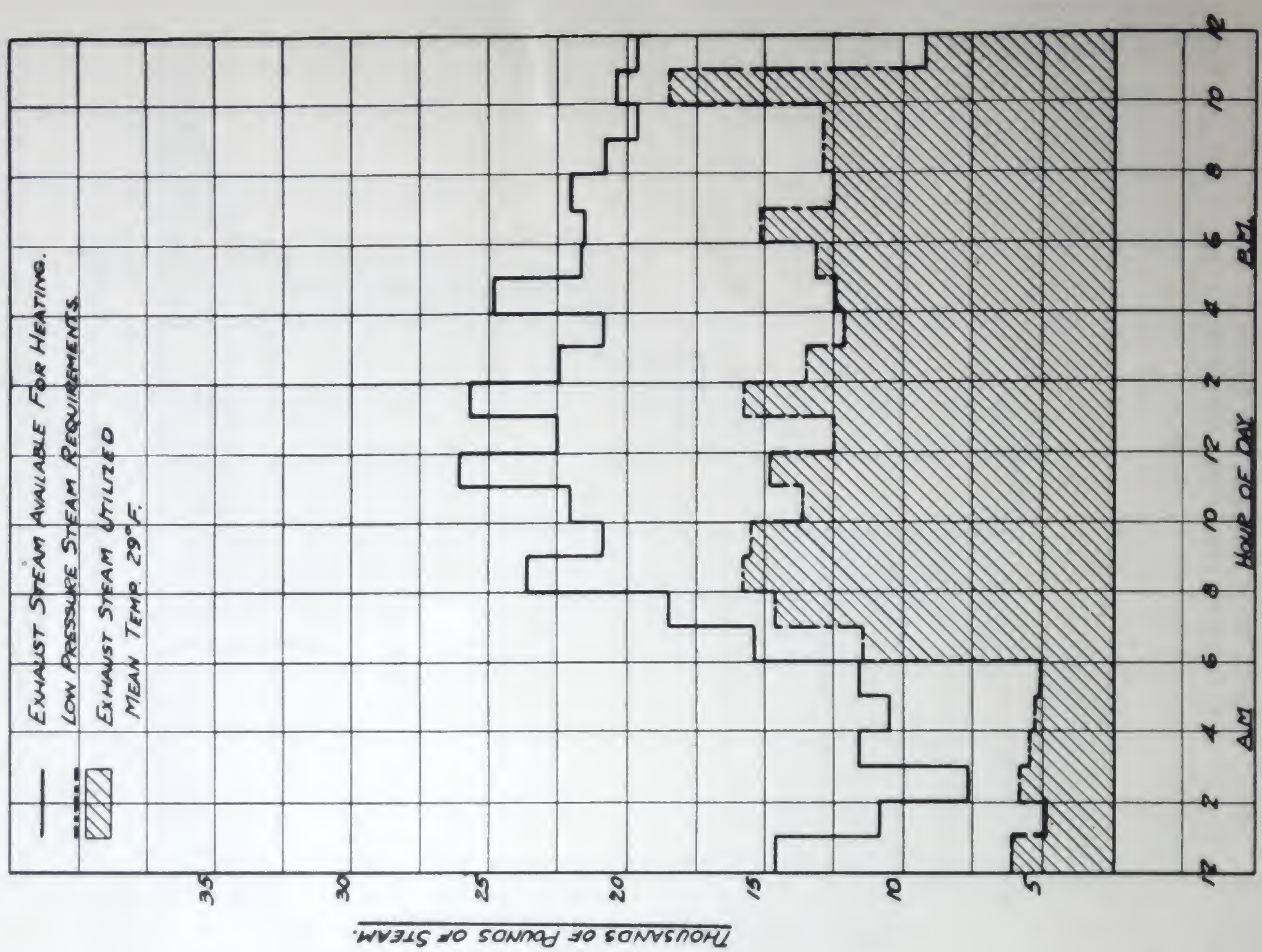


Fig. 19—Eight-Hundred-Forty Room Hotel—Typical Daily Steam Load Curve

ing season falling in each 5-deg step was determined from weather bureau records and by multiplying exhaust steam utilized for each curve by the number of days whose mean temperature fell within the 5-deg step of that curve, the total exhaust steam used during the heating season was determined. This is shown in the lower curve in Fig. 12. Dividing this total by the total available gives the ratio, which, in case of this 22-story office building, was only 9.6 per cent. This would be a low figure for the average office building as the quantity of steam used by this building is unusually low due to the fact that it is exceptionally well managed. The heating system is kept in a state of high efficiency at all times. In general, due to close pressure regulation and usage in proportion to weather conditions, greater economy always is effected with purchased steam than with private plant operation. Unnecessary losses during mild weather periods and night hours are eliminated.

Results of Summary

From the data and curves the following results were obtained:

	Lb
Exhaust steam available	71,482,000
Exhaust utilized	6,842,000
Exhaust to atmosphere	64,640,000
Live steam make-up	408,000
Total steam used	7,250,000
Percent exhaust steam utilized	9.6

These calculations were all based on data established for the 1926-1927 heating season which contained 5,313 deg-days. This was 102.5 per cent of a normal heating season for the Pittsburgh district.

Figs. 19 and 19-a show daily and yearly steam and electric load curves for an 840-room hotel. Although this hotel always has purchased power and steam services, a study was made to determine its operating costs with a private generating plant. It was assumed that Uniflow engine generators with a water rate of 33.2 lb of steam per kwhr would be installed. Assuming a loss of 10 per cent due to leaks, condensation, etc., the exhaust steam available would be 30 lb per kwhr.

Taking the total kilowatthours used over a period of a year, as metered by the electric service company's meters, and applying the factor of 30 lb per kwhr, the curve for total exhaust steam available was obtained. Steam meters used by the heating company for billing purposes registered the total low-pressure steam used for building heating and water heating. The high-pressure steam service for the kitchen equipment was metered by a steam flow meter on an individual high-pressure line. Since this service could not be supplied with exhaust steam it is represented on the curve as high-pressure steam supplied direct from the boiler plant.

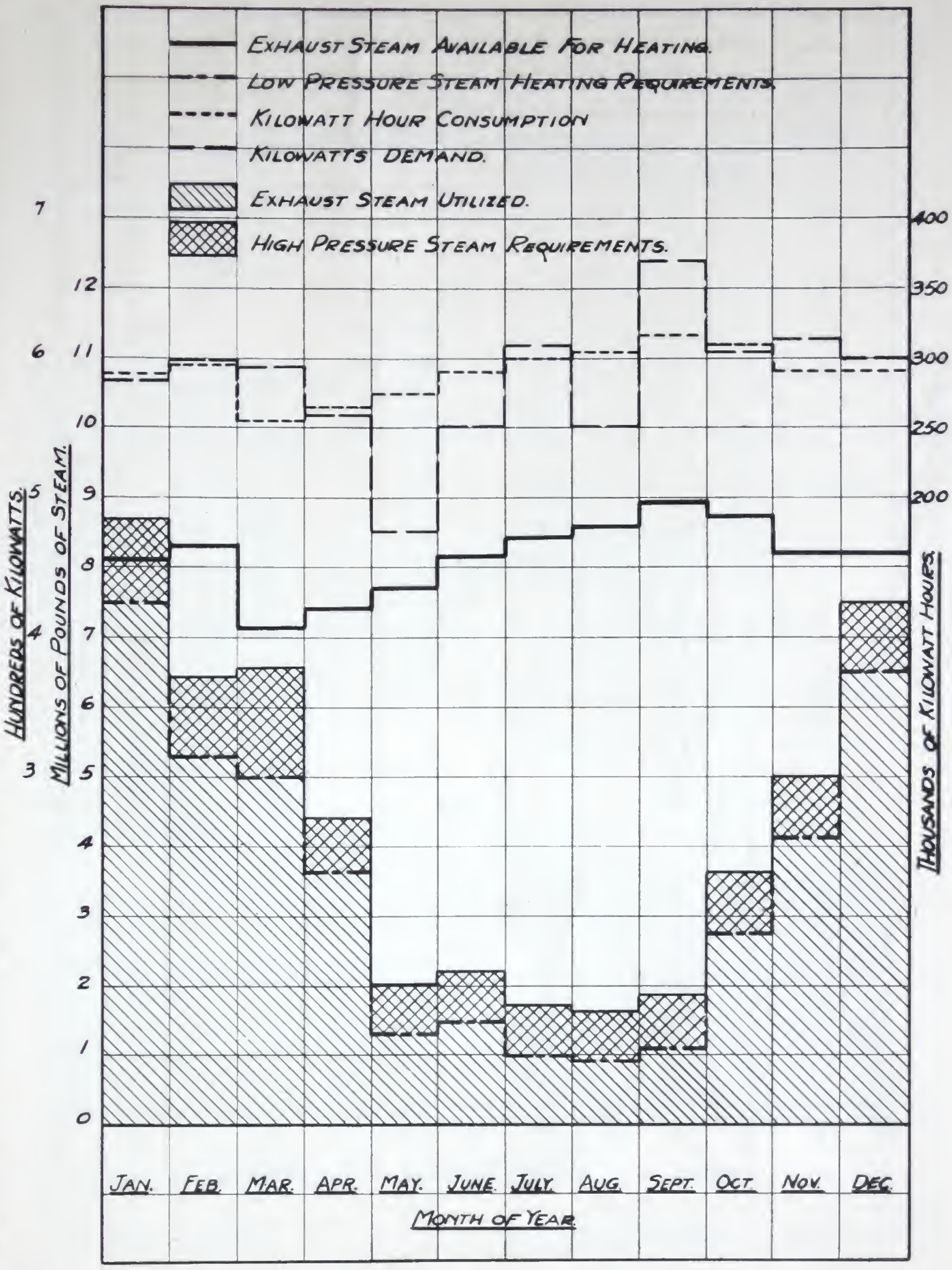


Fig. 19-a—Eight-Hundred-Forty Room Hotel—Yearly Steam and Electric Load Curves

The following figures give the results of this study, which are shown graphically in Fig. 19-a.

	Lb
Exhaust steam available for heating	104,520,000
Exhaust utilized for heating	40,660,000
Exhaust to atmosphere	63,860,000
Live steam make-up	10,960,000
Total steam used	51,620,000
Percent exhaust steam utilized	38.9

The consumption for heating used in this case occurred during the year 1927, which totaled 4,963 deg-days or 95.6 per cent of a normal year of 5,189 deg-days for the district in which the hotel is located.

Where meter tests are made to determine heating costs for a building where an isolated plant exists, care must be exercised in the location of these meters. In places where the condensate is not returned as in cooking, baking and laundry work, the steam used can be measured with steam flow meters. In some cases an estimate is sufficiently accurate as the steam used for such purposes is usually a small percentage of the total.

It is of vital importance to ascertain whether or not injection water is used to cool the condensate where it enters the vacuum pump. If it is used it must

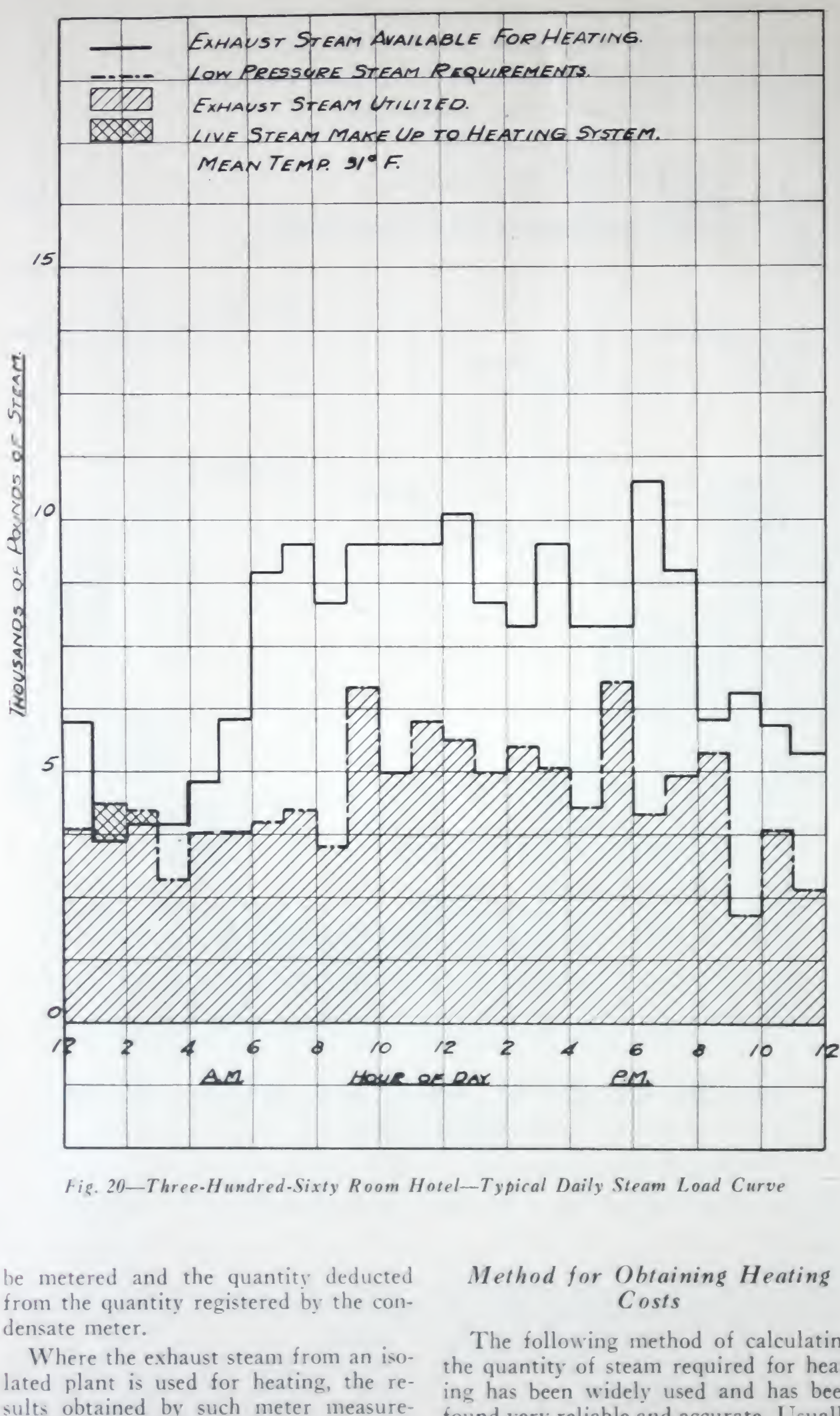


Fig. 20—Three-Hundred-Sixty Room Hotel—Typical Daily Steam Load Curve

be metered and the quantity deducted from the quantity registered by the condensate meter.

Where the exhaust steam from an isolated plant is used for heating, the results obtained by such meter measurement must not be taken as the actual quantity necessary for heating but should be used only as an approximate check. The engineer or manager of a building with an isolated plant invariably pays little attention to the condition of valves, radiator traps, etc., or to economies in the use of steam because they often are under the impression that the heating costs nothing since it is supplied from exhaust steam. Consequently the quantity used is frequently much greater than necessary.

Method for Obtaining Heating Costs

The following method of calculating the quantity of steam required for heating has been widely used and has been found very reliable and accurate. Usually it is referred to as the degree-day method and is recommended by the National District Heating Association. Figs. 1-e, 1-f and 1-g show forms which provide the data required in making the calculations. The formula is as follows:

$$P = \frac{H \times D \times 24}{L}$$

P = Pounds of steam per year.

H = Heat losses of building in B.t.u. per hour per degree difference between inside and outside temperatures. Details of the method of calculating these losses are given below.

D = Degree-days per year; degree-days being considered as the sum of the differences between the average daily outside temperature and 65F, for each day in the heating season, 65F being considered the outside temperature at which no heat is required. It is assumed that an average temperature of 65F is maintained in the building over 24 hr, that is, a temperature of 70F for 12 hr during the day and 60F for 12 hr at night. The heating season in Pittsburgh, Pa., is considered as 210 days and the number of degree-days as determined from the daily average temperature as established for 50 yr by the local weather bureau is 5,189.

L = Latent heat of steam (970 B.t.u. assumed available for low-pressure steam).

Simplifying the above formula by substituting 970 for L,

$$P = .0248\ H\ D$$

After the quantity of steam required has been determined by this formula, the coal required can be obtained by applying an evaporation rate. If steam can be purchased from a central heating company it will be necessary to divide the total steam for the season into monthly quantities and then apply the rate under which the steam is purchased. For this purpose a table similar to Table I can be used.

TABLE I

Monthly Heating Requirements in Percentages of Total Annual Steam for Pittsburgh District

	Deg Days	Percentage of Total Steam for Year
January	1,068	20.6
February	915	17.6
March	786	15.1
April	415	8.0
May	91	1.8
June	—	—
July	—	—
August	—	—
September	15	.3
October	290	5.6
November	654	12.6
December	955	18.4
Total	5,189	100.0

Calculation of Heat Losses

The heat losses of a building may be computed to a fair degree of accuracy by using the standard method adopted by the National District Heating Association.

Theoretically one B.t.u. will raise the temperature of 55 cu ft of air 1F. Al-

lowing for safety and simplicity in figuring, 50 cu ft is used, which makes the constant for one air change 0.02 B.t.u. per cu ft.

In computing the heat losses for well constructed office buildings and hotels, good practice allows for one change of air per hour; for well constructed store buildings two air changes per hour. For buildings of loose construction and those having a forced method of ventilation, more air changes per hour must be considered, the actual number depending on conditions.

The first step is to compute the B.t.u. per hour required by infiltration or air change by multiplying the cubical contents of the building by the proper factor as set up in the right hand column of Table II.

TABLE II*

Number of Air Changes	Btu per cu Ft. per Deg
½	.01
¾	.015
1	.02
1½	.03
2	.04
3	.06
4	.08

*From National District Heating Association Handbook.

The second step involves the computation of the B.t.u. per hour lost through the doors and windows by multiplying their area by the proper factor as found in Table III. The heat loss through door areas is considered the same as that of windows.

Finally the B.t.u. per hour lost through walls, floors, roofs and ceilings, which are exposed to the outside air are computed by applying the proper factor as found in Table III.

Radiation Required and Demand

For steam radiation (2 to 3 lb pressure) the number of square feet of direct radiation may be computed by dividing the sum of the heat losses per hour by 250.

To compute the maximum demand in pounds of steam per hour, a close estimate may be obtained by using 0.3 lb per sq ft of radiating surface required or installed.

TABLE III*

Walls	B.t.u. Per Hr Per Sq Ft Per Deg
Windows, single glass, full sash area	1.25
Windows, double glass, full sash area	.60
Plate glass	1.00
Skylight, single glass, full sash area	1.10
Skylight, double glass, full sash area	.60
Wooden door, 1 in.	.40
Wooden door, 2 in.	.36
Brick wall, 8½ in. plain	.37
Brick wall, 13 in. plain	.29
Brick wall, 17½ in. plain	.24
Brick wall, 22 in. plain	.21
Brick wall, 27 in. plain	.19
Concrete, 2 in. solid	.78
Concrete, 3 in. solid	.71
Concrete, 4 in. solid	.66
Concrete, 6 in. solid	.56
Frame wall (plaster, lath, stud clapboard)	.50
Frame wall (as above plus sheathing)	.28
Frame wall (as above plus sheathing and paper)	.28
Hollow tile, 2 in., ½ in. plaster both sides	.41
Hollow tile, 4 in. ½ in. plaster both sides	.33
Hollow tile, 6 in. ½ in. plaster both sides	.28
Solid plaster partition, 2 in.	.60
Solid plaster partition, 3 in.	.50
Wooden beams planked over, as flooring	.17
Wooden beams planked over, as ceiling	.35
Lath and plaster ceiling, no floor above	.62
Lath and plaster ceiling, floor above	.25
Single ¾ in. floor, no plaster beneath	.45
Single ¾ in. floor plaster beneath	.26

Brick wall, furred and plastered, use 0.7 times non-furred.
Stone wall, use 1.7 times brick wall.

Roofs	
Sheet iron	1.26
Corrugated iron, without boards	1.81
Slate on wood framing	.83
Slate on 1 in. wood board	.39
Iron on tight wood sheathing	.28
Tar paper over 1 in. boards	.44
2 in. board, paper, tar and gravel	.26
Patent (tar, gravel and paper)	.30
Tiling, 1 in. or less	.80
Tile, no boards under	1.12
6 in. hollow tile covered with 2 in. concrete, tar and gravel	.40
8 in. hollow tile covered with 2 in. concrete, tar and gravel	.35
Book tile with wood ceiling	.25
Government tile with wood ceiling	.25
Reinforced concrete, without air space	.57
Reinforced concrete, with plaster including air space, cement with expanded metal reinforcing, asphalt and gravel covering	.20
Concrete with center filled, 2 in.	.80
Concrete with center filled, 4 in.	.60
Concrete with center filled, 6 in.	.54

*From National District Heating Association Handbook.

Additional Data

Heat, light and power costs for additional hotels and office buildings are given in the appendix, Figs. 21-a to 27-b beginning on the following page.

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BUILDING POWER COST DATA

Date on plant of	Joliet National Bank Bldg.		
Address	Joliet, Ill.	Use of Bldg.	Office

Building Description

Width	66'	Length	160'
Height	100'	No. floors and basement	6
No. of express elevators			None
No. of local elevators			1
No. of freight elevators			1

Description of Isolated Plant Equipment

Boilers

Item	No.	Rating	Manufacturer	Type	Press.	How Fired	Fuel
1.	2	100 HP	Heggie	Return tubular	100#	Hand	Coal
2.							
3.							
4.							

Generators

Item	No.	K.W.	Volts	Cycles	Speed	Driven by
1.	2	55	115	D. C.	290 r.p.m.	Reciprocating Engines
2.						
3.						
4.						

Isolated Power Plant Operating Cost

			Year 1922
Labor	1/4 Supt., 1 Engr.	1 day fireman 1 night fireman	$5040.00
Fuel	1138 tons coal at $6.00		6828.00
Water			2005.00
Removal of ashes (under labor)			- -
Oil, waste and supplies			290.00
Maintenance			1541.00
Value of floor space (not used with purchased electricity)			- -
Total yearly operating cost			$15,704.00

Fig. 21-a

Operating Cost with Central Station Service.

		Year 1925	
Average monthly maximum demand		52	KW
Average monthly current consumption		10,150	KWH
Total cost of equipping for Central Station Service		$2,000.00	
Yearly Operating Charges			
Labor	1/5 Supt., 1 Engr., 1 Fireman	$4,030.00	
Fuel	358 T Coal @ $7.00/T	2,506.00	
Water		847.00	
Removal of ashes (under labor)		- -	
Repairs and Maintenance	all machinery	968.83	
Oil, waste and supplies		25.00	
Steam service	lbs. steam	- -	
Electric service		4,411.35	
	Total Operating Charges	$12,788.18	
Fixed Charges			
Interest	6% of $2,000	120.00	
Taxes and insurance	2%	40.00	
Depreciation	6%	120.00	
Insurance		- -	
	Total Fixed Charges	$280.00	
	Total Operating Charges	$12,788.18	
	Total Yearly Cost of Operation	$13,068.18	

*Fixed charge to be based on cost of new equipment required for central station service, less salvage value of isolated plant equipment.

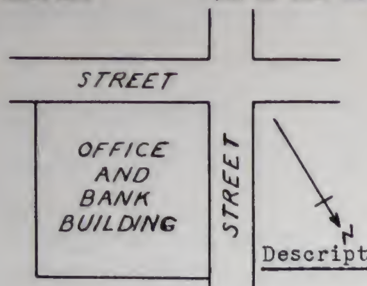
Building has 10,000 sq. ft. of radiation.

Fig. 21-b

BUILDING POWER COST DATA

Data on Plant of Bank and Office Building

Address Fourth and Wood St. Use of Bldg. Office



Building Description

Width	71	Length	81
Height	230	No. floors	16
No. of express elevators			3
No. of local elevators			3
No. of freight elevators			-

Description of Isolated Plant Equipment

Boilers

Item	No.	Rating	Manufacturer	Type	Press	How Fired	Fuel
1.	2	250	B & W	W.T.	120	Chain grates	Pgh. Coal
2.							
3.							
4.							

Generators

Item	No.	K.W.	Volts	Cycles	Speed	Driven by
1.	2	100	125	D. C.	290	Westinghouse Steam Eng.
2.	1	75	125		300	" " "
3.						
4.						

Isolated Power Plant Operating Costs

Labor	$ 10,271.00
Fuel	25,339.00
Water	600.00
Removal of ashes	1,200.00
Oil, waste and supplies	500.00
Maintenance	1,168.00
Boiler Insurance	50.00
Value of floor space	- -
Total yearly operating cost	$39,128.00

Fig. 22-a

Operating Cost with Central Station Service

Average monthly maximum demand	155 KW
Average monthly current consumption	22,500 KWH
Total cost of equipping for Central Station service	$18,000.00

Yearly Operating Charges

Labor	$ 4,680
Fuel	- -
Water	- -
Removal of ashes	- -
Repairs and maintenance	468
Oil, waste and supplies	250
Steam service lbs. steam	5,813
Electric service	9,632
Total Operating Charges	$20,843

*Fixed Charges

Interest 6% on $18,000.00	$ 1,080
Taxes 2% on $18,000.00	360
Depreciation 5% on $18,000.00	900
Insurance 1% on $18,000.00	180
Total Fixed Charges	$ 2,520
Total Operating Charges	20,843
Total Yearly Cost of Operation	$23,363

*Fixed charge to be based on cost of new equipment required for central station service, less salvage value of isolated plant equipment.

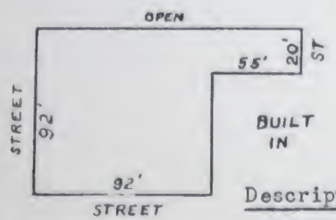
Fig. 22-b

BUILDING POWER COST DATA

Data on plant of Building

Address Philadelphia Use of Building Hotel

Building Description



Width	92'	Length	92'
Height	145'	No. floors	9
No. of express elevators			-
No. of local elevators			2
No. of freight elevators			2

Description of Isolated Plant Equipment

Boilers

Item	No.	Rating	Manufacturer	Type	Press.	How Fired	Fuel
1.	3	125	Coatesville	Tubular	77	Hand	Buckwheat Coal
2.							
3.							
4.							

Generators

Item	No.	K.W.	Volts	Cycles	Speed	Driven by
1.	1	125	120	D. C.	225 r.p.m.	Ball Recip. Engine
2.	1	75	120	D. C.	250	Ball Recip. Engine
3.						
4.						

Isolated Power Plant Operating Cost

Labor	$ 8,282.04
Fuel	10,356.00
Water	140.62
Removal of ashes	1,020.00
Oil, waste and supplies	2,500.00
Maintenance	- -
Value of floor space	- -
Total yearly operating cost	$22,298.66

Fig. 23-a

Operating Cost with Central Station Service

Average monthly maximum demand	30 Minute	66.3	KW
Average monthly current consumption		31,925	KWH
Total Cost of equipping for Central Station Service		- -	

Yearly Operating Charges

Labor	$6,982.04
Fuel	5,874.00
Water	4.56
Removal of ashes	600.00
Repairs and maintenance	1,000.00
Oil, waste and supplies	- -
Steam service lbs. steam	- -
Electric service	6,468.36
Total Operating Charges	$20,928.96

*Fixed Charges

Interest

Taxes

Depreciation

Insurance

Total Fixed Charges

Total Operating Charges

Total Yearly Cost of Operation

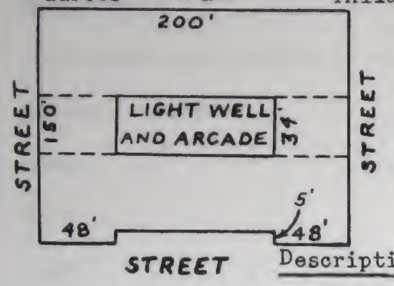
*Fixed charge to be based on cost of new equipment required for central station service, less salvage value of isolated plant equipment. Kindly note that the above estimates are for electric elevators and motor generator sets to provide for the existing direct current lighting system.

Fig. 23-b

BUILDING POWER COST DATA

Data on plant of Building

Address OPEN Philadelphia Use of Building Office



Building Description

Width 150'	Length 200'
Height 250'	No. floors 18
No. of express elevators	-
No. of local elevators	12
No. of freight elevators	3

Description of Isolated Plant Equipment

Boilers

Item	No.	Rating	Manufacturer	Type	Press.	How Fired	Fuel
1.	3	375	B. & W.	W. T.	130	Steam Atomizers	Oil
2.							
3.							
4.							

Generators

Item	No.	K.W.	Volts	Cycles	Speed	Driven by
1.	1	250	230	D. C.	125	Wetherill Cross Comp. Engine 15" x 24" x 36" - 36"
2.	3	400	230	D. C.	125	Wetherill Cross Comp. Engines 19" x 30" x 36"
3.						
4.						

Isolated Power Plant Operating Costs

Labor	$ 22,576.75
Fuel	77,212.82
Water	726.11
Removal of ashes	- -
Oil, waste and supplies	6,129.30
Maintenance	- -
Value of floor space	- -
Total yearly operating cost	$106,644.98

Fig. 24-a

Operating Cost with Central Station Service

Average monthly maximum demand	30 minutes	702.5 KW
Average monthly current consumption		311,764 KWH
Total cost of equipping for Central Station service		- -

Yearly Operating Charges

Labor	$ 17,466.75
Fuel	24,840.55
Water	76.99
Removal of ashes	- -
Repairs and maintenance	2,500.00
Oil, waste and supplies	- -
Steam service lbs. steam	- -
Electric service	39,164.16
Total Operating Charges	$84,048.45

*Fixed Charges

Interest

Taxes

Depreciation

Insurance

Total Fixed Charges

Total Operating Charges

Total Yearly Cost of Operation

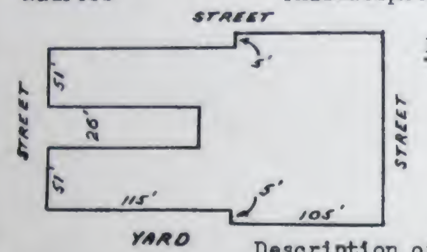
*Fixed charge to be based on cost of new equipment required for central station service, less salvage value of isolated plant equipment. Kindly note that the above estimates are for hydraulic freight elevators, electric passenger elevators and motor generator sets to provide for existing direct current lighting system.

Fig. 24-b

BUILDING POWER COST DATA

Data on plant of Building

Address Philadelphia Use of Building Office



Building Description

Width	138'	Length	220'
Height	130'	No. of floors	11
No. of express elevators			--
No. of local elevators			6
No. of freight elevators			1

Description of Isolated Plant Equipment

Boilers

Item	No.	Rating	Manufacturer	Type	Press.	How Fired	Fuel
1.	2	240	Edgemoor	F.T.	103	Hand	Buckwheat Coal (Rice)
2.	3	250	"	F.T.	103	"	" "
3.							
4.							

Generators

Item	No.	K.W.	Volts	Cycles	Speed	Driven by
1.	1	150	110	D. C.		Hbg. Std. Recip. Engine
2.	2	75	110	D. C.		" " " "
3.						
4.						

Isolated Power Plant Operating Costs

Labor	$ 11,981.25
Fuel	27,666.00
Water	346.96
Removal of ashes	1,375.00
Oil, waste and supplies	1,875.81
Maintenance	1,200.00
Value of floor space	- -
Total yearly operating costs	$44,445.02

Fig. 25-a

Operating Cost with Central Station Service

Average Monthly maximum demand	30 minute	214 KW
Average monthly current consumption		66,907 KWH
Total cost of eqipping for Central Station service		- -

Yearly Operating Charges

Labor	$8,460.00
Fuel	7,824.00
Water	14.80
Removal of ashes	389.10
Repairs and maintenance	600.00
Oil, waste and supplies	800.00
Steam service lbs. steam	- -
Electric service	10,942.92
Total Operating Charges	$29,030.82

*Fixed Charges

Interest	
Taxes	
Depreciation	
Insurance	
Total Fixed Charges	$ 2,728.56
Total Operating Charges	29,030.82
Total Yearly Cost of Operation	$31,759.38

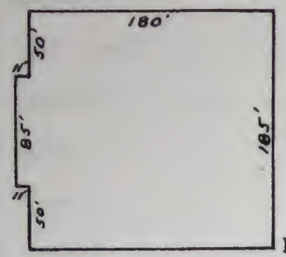
*Fixed charge to be based on cost of new equipment required for central station service, less salvage value of isolated plant equipment. Kindly note that the above estimates are for hydraulic elevators and alternating current operation of the plant.

Fig. 25-b

BUILDING POWER COST DATA

Data on plant of Building

Address Philadelphia Use of Bldg. Hotel



STREETS ON ALL SIDES

Building Description

Width	180'	Length	185'
Height	273'	No. floors	17
No. of express elevators			--
No. of local elevators			10
No. of freight elevators			2

Description of Isolated Plant Equipment

Boilers

Item	No.	Rating	Manufacturer	Type	Press	How Fired	Fuel
1.	5	300 HP	B. & W.	W.T.	135	Stoker	Buckwheat Coal
2.							
3.							
4.							

Generators

Item	No.	K.W.	Volts	Cycles	Speed	Driven by
1.	4	230	115	D. C.	100	Corliss Engines
2.						
3.						
4.						

Isolated Power Plant Operating Costs

Labor	$ 57,020.40
Fuel	114,700.00
Water	971.75
Removal of ashes	2,312.50
Oil, waste and supplies	1,697.20
Maintenance	Not given
Value of floor space	- -
Total yearly operating cost	$176,701.85

Fig. 26-a

Operating Cost with Central Station Service

Average monthly maximum demand	30 minute	716.5 KW
Average monthly current consumption		333,376 KWH
Average cost of equipping for Central Station Service		- -

Yearly Operating Charges

Labor	$41,868.00
Fuel	45,105.00
Water	76.04
Removal of ashes	909.38
Repairs and maintenance	Not given
Oil, waste and supplies	900.00
Steam service lbs. steam	- -
Electric service	41,190.60
Total Operating Charges	$130,049.02

*Fixed Charges

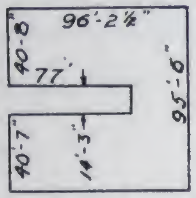
Interest	
Taxes	
Depreciation	
Insurance	
Total Fixed Charges	$ 6,799.68
Total Operating Charges	130,049.02
Total Yearly Cost of Operation	$136,848.70

Fig. 26-b

BUILDING POWER COST DATA

Data on plant of Building

Address Philadelphia Use of Bldg. Office



Building Description

Width	96' - 2½"	Length	95' - 6"
Height	146' - 6"	No. floors	13
No. of express elevators			--
No. of local elevators			4
No. of freight elevators			2

Description of Isolated Plant Equipment

Boilers

Item	No.	Rating	Manufacturer	Type	Press.	How Fired	Fuel
1.	2	200 HP	Keeler	Water Tube	125	Hand	Buckwheat Coal
2.							
3.							
4.							

Generators

Item	No.	K.W.	Volts	Cycles	Speed	Driven by
1.	1	75	125	D. C.	275 r.p.m.	17"x12") Ames Tandem 11"x12") Comp. Engine
2.	1	75	125	D. C.	275 r.p.m.	13"x12") Ames slide valve engine
3.						
4.						

Isolated Power Plant Operating Costs

Labor	$ 11,013.75
Fuel	12,644.25
Water	133.80
Removal of ashes	1,099.50
Oil, waste and supplies	3,035.92
Maintenance	
Value of floor space	
Total yearly operating cost	$ 27,927.22

Fig. 27-a

Operating Cost with Central Station Service

Average monthly maximum demand	30 minute	139.3	KW
Average monthly current consumpiton		62,227	KWH
Total cost of equipping for Central Station Servise		- -	

Yearly Operating Charges

Labor	$6,671.25
Fuel	3,455.75
Water	5.17
Removal of ashes	300.50
Repairs and maintenance	500.00
Oil, waste and supplies	- -
Steam service lbs. steam	- -
Electric service	$10,494.24
Total Operating Charges	21,426.91

Fig. 27-b

COMMERCIAL NATIONAL SECTION

Commercial and Industrial Power and Heating Bureau

(Administrative Year, July 1, 1930—June 30, 1931)

Chairman, W H Sammis, Commonwealth & Southern Corp, New York, N Y

GENERAL POWER COMMITTEE

Scope: *To act as a clearing house for competitive power problems; to obtain data on power costs in isolated steam, gas and oil engine plants; to study and extend the use of new and specific applications of electric power in commercial and industrial fields.*

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Vice-Chairman, L J Lamberger, Duquesne Light Co, Pittsburgh, Pa

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Great Lakes—C H Purdy, Consumers Power Co, Jackson, Mich
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Operating Cost with Central Station Service

BUILDING POWER COST DATA